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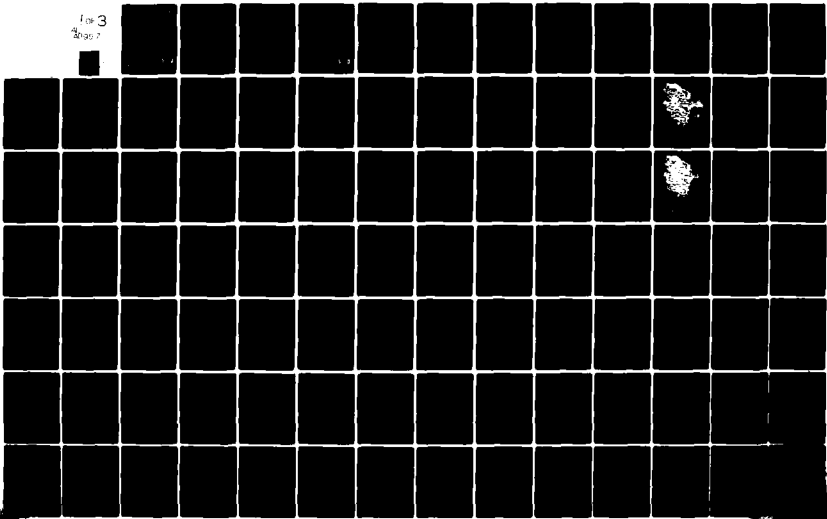

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CULTURAL RESOURCES

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This technical report provides a working definition of cultural resources and reviews the historic preservation system and its applications for Air Force deployment of M-X in Nevada/Utah and Texas/New Mexico. National Register properties, previous research, culture history, and a review of known archaeological and historical and architectural porperties is provided for each study area. In support of the M-X DEIS, a section on impact assessment has been included which addresses impact significance, methodology, impacts of the M-X

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1.0 GENERAL INTRODUCTION

Cultural resources, those archaeological and historical properties determined to be of local, state, and national significance, are further recognized as non-renewable resources which will be adversely impacted by deployment of the M-X system. As such, this technical report provides a working definition of cultural resources and reviews the historic preservation system and its applications for Air Force deployment of M-X in Nevada/Utah and Texas/New Mexico. National Register properties, previous research, culture history, and a review of known archaeological and historical and architectural properties is provided for each study area. In support of the M-X DEIS, a section on impact assessment has been included which addresses impact significance, methodology, impacts of the M-X system and its alternatives, and tables which indicate estimated impact levels in a standardized format. Because the technical report is in draft form, it is expected that a number of sections will undergo revision prior to final publication.

1.1 DEFINITION OF CULTURAL RESOURCES

The terms cultural resources and historic properties are generally used interchangeably. In this report cultural resources are defined to include prehistoric and historic districts, sites, structures, and other evidence of human use considered to be of some importance to a culture, a subculture, or a community for scientific, traditional, religious, and other reasons. These resources may be prehistoric aboriginal sites, historic Native American and Euroamerican areas of occupation and activity, and features of the natural environment.

1.2 STATUTORY AUTHORITY

CULTURAL RESOURCE LAW AND THE COMPLIANCE PROCESS

Cultural resources are protected by a number of laws. The principal ones are briefly summarized here, and the procedures for complying with these laws are discussed. The agencies involved and the relationship between agencies are outlined. The system that has resulted from this legal base is generally referred to as the historic preservation system.

I. CULTURAL RESOURCE LAWS AND REGULATIONS:

1. National Historic Preservation Act (NHPA)

This law created the National Register of Historic Places and established the Advisory Council on Historic Preservation. Section 106 of this act requires that federal agencies take into account the effect of any undertaking on properties included on or eligible for the National Register. In addition, the Advisory Council must be afforded an opportunity to comment on such an undertaking.

2. National Environment Policy Act

This act and the guidelines of the Council on Environmental Quality (CEQ) require federal agencies to consider and evaluate the impact on the environment of all federal actions. Potential impacts to cultural resources are considered as part of this process.

3. Executive Order 11593

Directs federal agencies to identify and nominate historic properties to the National Register (this part of the Order applies to land holding agencies). The Order also requires that all federal agencies exercise care to avoid unnecessarily damaging properties that might be eligible for the National Register.

4. Archaeological and Historic Preservation Act (sometimes referred to as the Moss-Bennett Act)

This law authorizes federal agencies impacting archaeological and historic resources to expend funds (up to one percent of total project cost) for the proper recovery of data from these resources. Such funds are made available after project impacts have been identified and assessed in the project planning process. This Act also authorizes Interagency Archaeological Services (IAS) of the Heritage Conservation and Recreation Service to review data recovery program to ensure that they comply with historic preservation legislation.

5. 36 CFR 800 - Advisory Council Guidelines on the Protection of Historic and Cultural Properties

These regulations implement Section 106 of the National Historic Preservation Act and Executive Order 11593, and they provide step-by-step procedures for compliance with the above legislation.

II. PARTICIPANTS IN THE HISTORIC PRESERVATION SYSTEM

The major participants in the historic preservation system and their relationships are outlined in Figure 1.2-1.

1. The Advisory Council on Historic Preservation

The Advisory Council became an independent agency of the U.S. government in 1976. The division known as the Office of Review and Compliance enforces agency compliance with the Council's procedures, comments on environmental impact statements, and alerts agencies when they appear to be in non-compliance. The Council guidelines, 36 CFR 800, define the Council's functions. Principally, the Council must be afforded an opportunity to comment on any project having an effect on cultural resources. If the effect is adverse, the Council is party to the execution of a Memorandum of Agreement which details the actions to be taken by the Agency with the concurrence of the SHPO to avoid or mitigate the adverse effects on the cultural resources.

2. Heritage Conservation and Recreation Service (HCRS)

HCRS was established by the Secretary of the Interior on January 25, 1978. It encompasses the functions and authorities of the former Bureau of Outdoor Recreation and the Office of Archaeology and Historic Preservation (OAHP) which was previously assigned to the National Park Service.

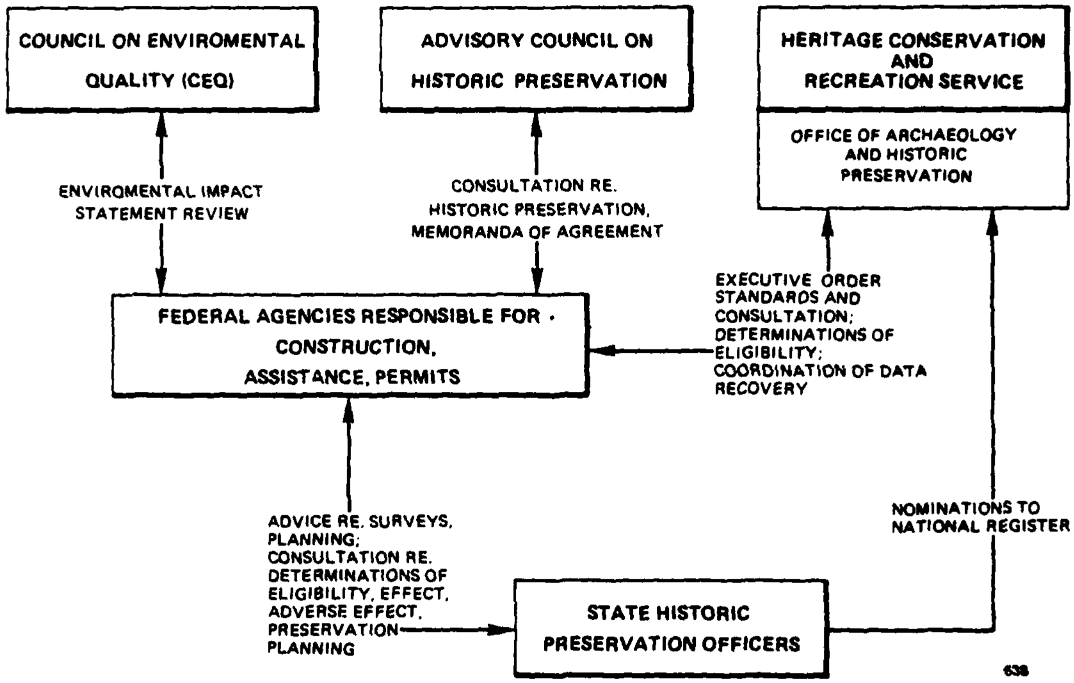

Figure 1.2-1. The historic preservation system: major participants and relationships.

3. Office of Archaeology and Historic Preservation (OAHP)

Numerous historic preservation programs fall under OAHP. Two key divisions include the National Register of Historic Places and Interagency Archaeological services.

National Register

This division receives nominations of properties to the Register from other agencies, verifies the accuracy of the information, accepts or rejects property nominations, and publishes an updated listing of National Register properties. As a result of E.O. 11593, federal agencies are required to take care not to damage Register-eligible properties. This division processes requests for "determinations of eligibility" after these requests have been reviewed by the SHPO.

Interagency Archaeological Services: (IAS)

As its name suggests, a major function of this division is to assist other federal agencies to comply with cultural resource legislation. Frequently, this means actually assuming responsibility for the identification (inventory) and evaluation of cultural resources within the project area which may be eligible for the National Register, and taking the appropriate mitigation measures. To do this, IAS can either perform the necessary work themselves or subcontract for these services. The agency transfers funds to IAS sufficient to achieve compliance with preservation legislation, and IAS charges the agency a percentage of the total amount of contract services for facilitating the agency's compliance requirements. In addition, IAS serves in a review capacity at various project phases.

4. State Historic Preservation Officer

The SHPO is a key participant in the historic preservation system and is consulted and involved at every step in the compliance process. The SHPO is responsible for a wide range of activities including supervision of the State Historic Preservation staff, ensuring that nominations are prepared and submitted to the National Register, supervision of an environmental review process to ensure that historic properties are considered in federal planning, participation in the compliance activities of federal agencies under the procedures of the Advisory Council, and supervision of comments on environmental impact statements. The SHPO is a political appointee of the governor, and the minimum requirements for the staff are that it include a professional archaeologist, historian, and architect or architectural historian. Professional qualifications for this staff are outlined in 36 CFR 61.5.

5. Land Management Agencies

Agencies such as the BLM are directed by E.O. 11593 to inventory all properties on their lands which qualify for the National Register. Considering the vast area to be surveyed, fulfillment of this requirement will take many years of survey work. Another requirement is to ensure that potentially qualifying properties are not impacted. Therefore, not only must the impacts of BLM projects be assessed but the impacts of other agency projects are, in part, their responsibility as well. Cooperation is required, but the agency responsible for the potential impacts is usually considered the lead agency responsible for complying with preservation legislation.

6. Construction Agencies

Agencies involved in construction have some of the clearest responsibilities. They must identify archaeological and historical properties subject to direct and indirect impacts and determine the eligibility of such properties to the National Register in consultation with the SHPO and Advisory Council. These consultations and the studies undertaken to identify cultural resources should be documented in any environmental impact statement prepared on the project.

III. COMPLIANCE WITH CULTURAL RESOURCE LEGISLATION

While it is mandated by NEPA that the potential for impacts to cultural resources be considered as part of the environmental planning process for a project, the historic preservation system has developed specific procedures for implementing this requirement (Figure 1.2-2). Three general points regarding Figure 2 emphasize that historic preservation studies are required early in the environmental planning process:

- o Preliminary consultation with the SHPO is required in order to determine the need for a survey.
- o Intensive survey is implemented after consultation with the SHPO.
- o Determination of eligibility to the National Register, determination of effect, and development of a preservation plan generally should occur by the time a Draft EIS is issued.

Once a complete inventory of the cultural resources within a project area has been assembled (which almost always requires an intensive survey of the entire area), then the federal agency must comply with the regulations established by the Advisory Council on Historic Preservation in 36 CFR 800 (Figure 1.2-3). This involves submitting the cultural resource inventory to the SHPO whose responsibility it is to determine which of the properties in the inventory are listed on or eligible for the National Register. The SHPO then determines whether the project will have any effect on National Register or Register-eligible properties. A "no effect" determination enables the project to proceed without further consultation. If the SHPO determines there will be an effect, then it is necessary to apply the criteria of "adverse effect" (36 CFR 800.3). A "no adverse effect" determination is usually possible in situations where the SHPO decides that the property that will be affected has only scientific value that may be preserved by implementation of a data recovery program. After making such a determination the SHPO forwards this opinion and relevant documentation to the Advisory Council for their comment. If the Advisory Council concurs, a data recovery program is implemented and the project is authorized to proceed.

If there is a determination of "adverse effect" by SHPO, or if the Advisory Council objects to a "no adverse effect" determination, then there must be consultation between the Agency, the SHPO, and the Advisory Council. This

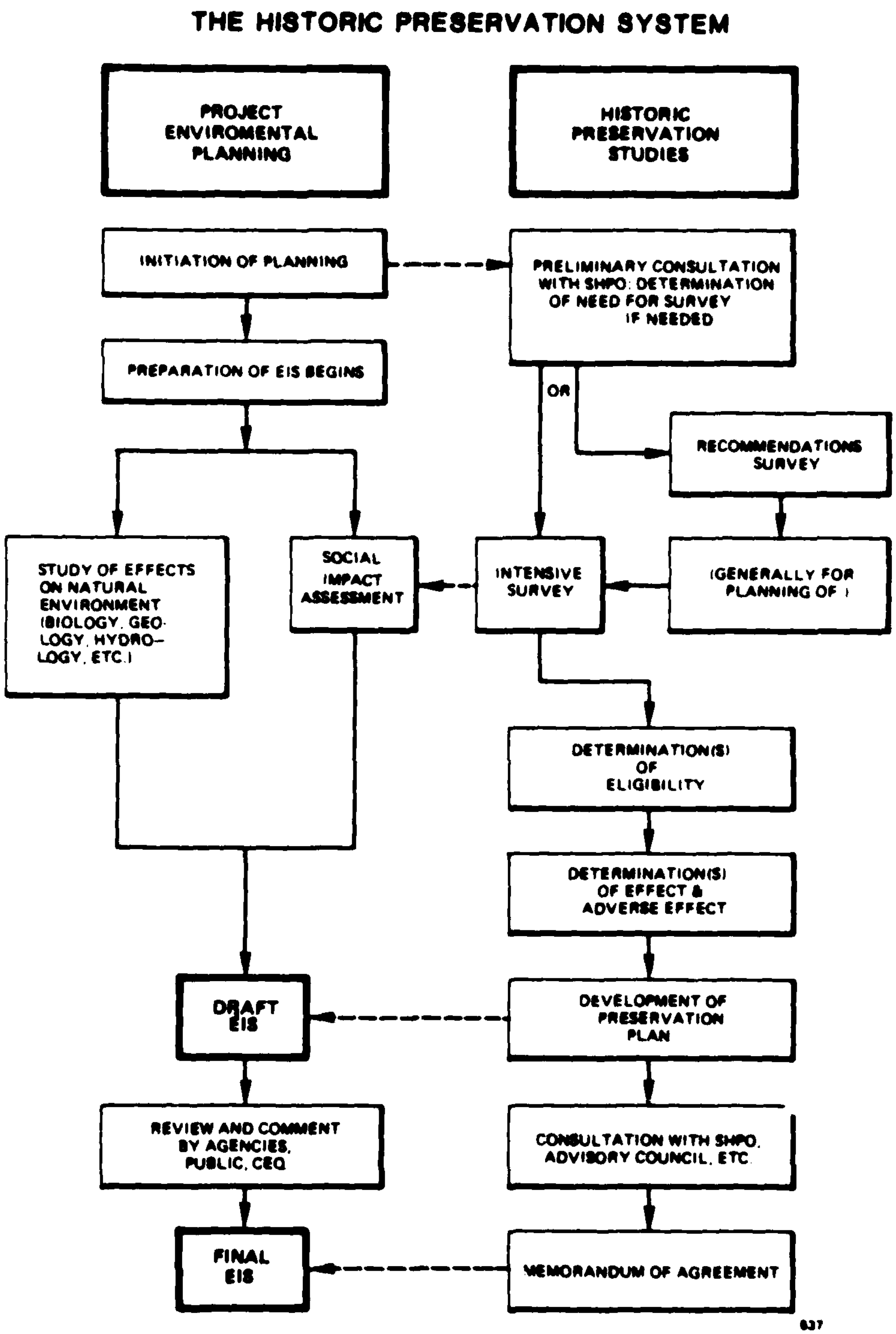

Figure 1.2-2. General relationship of historic preservation to environmental planning on a federal project.

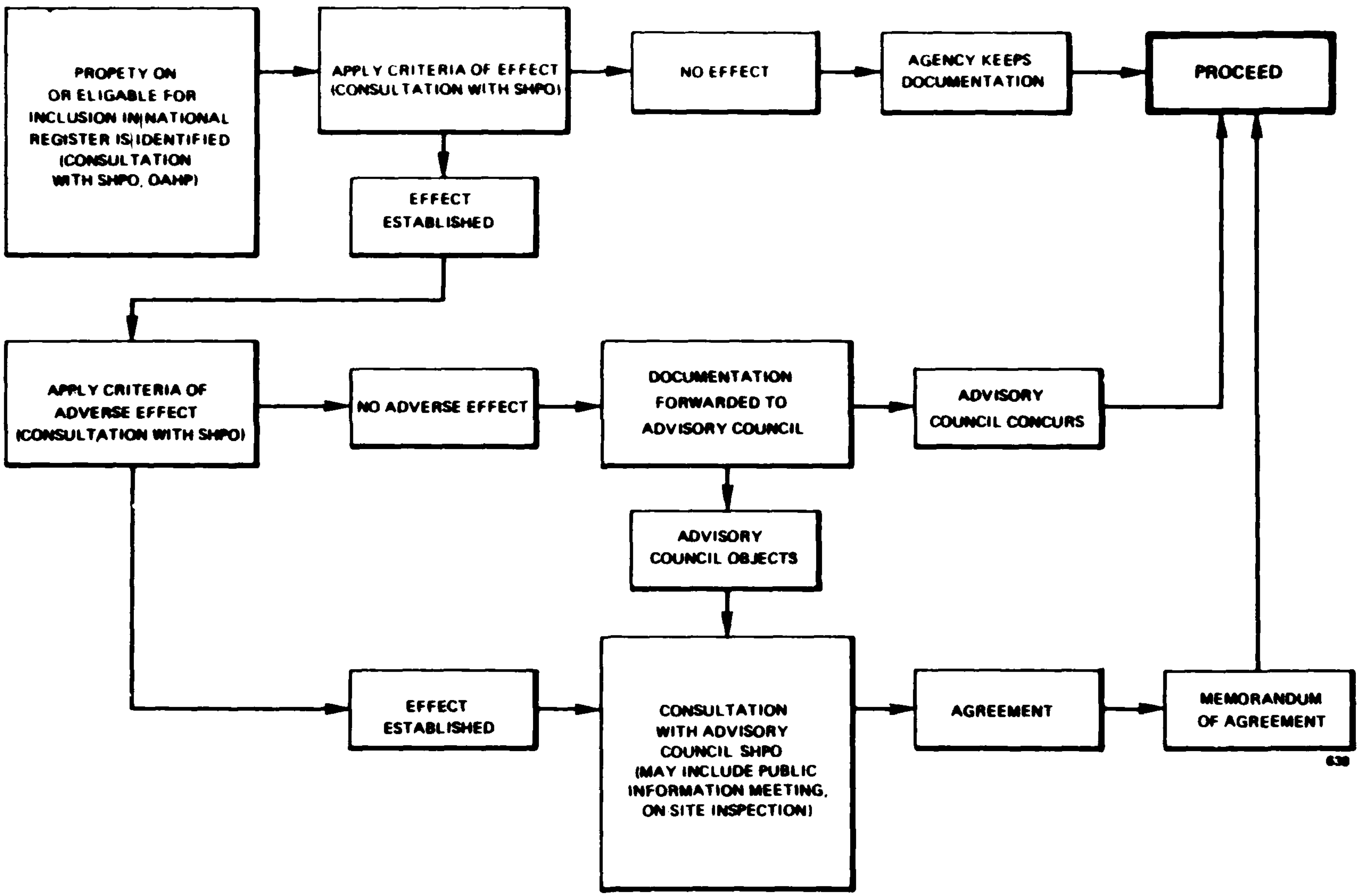

Figure 1.2-3. Procedures of the Advisory Council on Historic Preservation (36 CFR Part 800).

consultation process results in a Memorandum of Agreement between the involved parties as to the measures that are to be taken to mitigate the adverse effect on cultural resources. Implementation of these measures--usually a data recovery program--is required before the project can proceed.

The consultation process required of an "adverse effect" determination is outlined in 36 CFR 800.6b. This process involves the Agency or agencies, the SHPO, and the Advisory Council as consulting parties to consider measures that could avoid, mitigate, or minimize adverse effects to cultural resources. To initiate the consultation process, the Agency is required to submit a "preliminary case report" (36 CFR 800.13b) with a request for comments to the Advisory Council. The report is also made available to the SHPO, other appropriate agencies, and the public. At the request of any of the consulting parties, an on-site inspection can be conducted. Similarly, the Advisory Council can conduct a public information meeting near the site of the undertaking where representatives of national, state, and local government, and public and private organizations, and interested citizens may receive information and express their views. After the public meetings, the consulting parties determine which are the most satisfactory alternatives, avoidance procedures, or other mitigation measures. These measures are then detailed in a proposal prepared by the Agency for inclusion in the Memorandum of Agreement, and the concurrence of the SHPO must be included. The MOA is then forwarded to the Chairman of the Advisory Council for ratification which requires a 30 day review period. At the end of the review period, notice of the ratified MOA is published in the Federal Register, and the MOA should be included in the final environmental impact statement. The MOA constitutes the comments of the Advisory Council and fulfills the Agency's requirements to comply with the legislation.

IV. THE PROGRAMMATIC MEMORANDUM OF AGREEMENT

An alternative approach to compliance is the Programmatic Memorandum of Agreement (PMOA). Because of the large scale land requirements and significant potential impacts to result from deployment of the M-X system during a multi-year construction period, the USAF, in consultation with the Advisory Council and the SHPOs and other concerned agencies, has sought the execution of a PMOA (Appendix A). This agreement, if implemented, will satisfactorily mitigate or avoid the adverse effects of M-X deployment on historic and cultural properties. The following procedures are followed in the development of a PMOA.

1. An official from the lead agency (in the present case the U.S. Air Force) requests of the Advisory Council the execution of a PMOA. The Executive Director of the Advisory Council determines whether a PMOA may be used and notifies the Agency Official within 30 days.

2. The PMOA is developed by the Executive Director and the Agency Official. In addition, when the Agreement will affect a particular state or states, the appropriate State Historic Preservation Officer may be a party to the consultation. When the Agreement involves issues national in scope, the President of the National Conference of State Historic Preservation Officers or designated representative may be a party to the consultation. The Executive Director may invite other parties, including other federal agencies with responsibilities which may be affected by the

Agreement to participate in the consultation and may hold a Public Information Meeting (see 800.6(b)(3) on the proposed Agreement.

3. At least 30 days prior to executing a PMOA, the Advisory Council must publish a notice of their intent in the Federal Register inviting comments. They must make copies of the proposed PMOA available to interested parties and appropriate A-95 clearinghouses.

4. Any comments received must be considered before a final version of the PMOA is ratified by the Executive Director, the Agency official, and other involved parties.

5. The signed PMOA is then forwarded to the Chairman of the Advisory Council who has 30 days to:

    a. Ratify the Agreement, at which time it will take effect.

    b. Submit the Agreement to the full Council for approval.

    c. Disapprove the Agreement.

6. Notice of an approved PMOA is published in the Federal Register. Copies should be sent to appropriate A-95 clearinghouses, should be made available to the public on request, and should be published in a Final EIS.

7. The PMOA remains in effect until revoked by any of the signatories. The Agency Official must submit an annual report on all actions taken pursuant to the PMOA.

1.3 SIGNIFICANCE OF ARCHAEOLOGICAL, HISTORICAL, AND ARCHITECTURAL RESOURCES

SCIENTIFIC SIGNIFICANCE

Cultural resources are evaluated for their potential to establish reliable generalizations about human behavior, particularly explanation of variability and change in societies and cultures. Generalizations and explanations require controlled comparison of relevant data concerning past human life. This includes such things as artifacts, settlements, food remains, and evidence for past environments. Scientific significance depends on the degree to which archaeological resources in the project or program area contain data appropriate for answering various substantive, technical, methodological, or theoretical questions. The value of these data should be determined in the regional context of the project or program and in relation to general anthropological problems.

CULTURAL SIGNIFICANCE

Cultural resources are evaluated in terms of those values consisting of the direct and indirect ways in which society at large benefits from study and preservation of cultural resources. Benefits which should be described and included are: (1) the acquisition of knowledge concerning man's past and its potential use,

(2) the acquisition and preservation of objects, sites, structures, etc. for public education and enjoyment, (3) education and economic benefits from archaeological exhibits, and (4) practical applications of scientific findings acquired through archaeological investigations.

In addition, sites of cultural significance to Native Americans are assessed for their secular or sacred value.

NATIONAL REGISTER SITES AND ELIGIBLE PROPERTIES

Cultural resources are evaluated in terms of the criteria for evaluation for inclusion on the National Register as defined in 36 CFR 60.6.

> 60.6 Criteria for evaluation
>
> The criteria applied to evaluate properties for possible inclusion in the National Register are listed below. These criteria are worded in a manner to provide for the diversity of resources. The following criteria shall be used in evaluating properties for nomination to the National Register, by the National Park Service in reviewing nominations, and for evaluating National Register eligibility of properties affected by federal agency undertakings.
>
> National Register criteria for evaluation: The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> (a) That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) That are associated with the lives of persons significant in our past; or
>
> (c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> (d) That have yielded, or may be likely to yield, information important in prehistory or history.

Criteria considerations: Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

> (a) A religious property deriving primary significance primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event.

(b) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event.

(c) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

(d) A cemetery which derives its primary significance from graves of persons of trancendent importance, from age, from distinctive design features, or from association with historic events.

(e) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived.

(f) A property primarily commemorative in intent of design, age, tradition, or symbolic value has invested it with its own historical significance.

(g) A property achieving significance within the past 50 years if it is of exceptional importance.

2.0 NEVADA/UTAH CULTURAL RESOURCES

2.1 NATIONAL AND STATE REGISTER PROPERTIES

The National Register of Historic Places is the nation's official list of properties worthy of preservation for significance in American history, architecture, archaeology, and culture.

All historic and prehistoric properties listed on or pending nomination to the National Register are shown in Figure 2.1-1. In the Nevada study area, there are currently 45 properties listed on the National Register and 10 properties currently pending nomination or in preparation for nomination (Table 2.1-1). In the Utah study area, there are currently 49 properties listed in the National Register and 6 properties pending nomination (Tables 2.1-2 and 2.1-3). Utah has a State Register of Historic Places (Table 2.1-4). Nevada has only recently established a State Register, and there are no entries as yet.

There has been no systematic effort to make determinations of National Register eligibility for the known archaeological, historical, and architectural sites of the Nevada/Utah study region. Current and pending listings tend to include a greater proportion of historica and architectural properties than archaeological sites, yet even for historic and architectural properties are the current listings neither exhaustive nor even representative of the total range of potentially eligible properties. Thus current National Register listings must be viewed as a small fraction of the potentially eligible properties within the study region.

The regional sample survey, the initial phase of which was implemented in Summer 1980, will provide a regional context within which to evaluate the scientific significance of cultural resources that will be directly and indirectly impacted by project implementation. Other studies, such as the Native American regional surveys, will provide essential information for assessing the cultural significance of these resources. Thus, when preconstruction studies are implemented, the cultural resources encountered will be assessed as to their National Register eligibility under the procedures outlined in the PMOA (Appendix A).

2.2 ARCHAEOLOGICAL RESOURCES

Information about the aboriginal groups that inhabited the Nevada/Utah study region for the last 11,000 years is presented in this section. As introductory material the history of previous research is reviewed, then the regional culture history and a list of current research problems are reviewed. Finally existing data from the Great Basin study region is examined in some detail.

REVIEW OF PREVIOUS RESEARCH (2.2.1)

Previous archaeological research in central Nevada has involved both survey and excavation, but since few areas have been intensively studied, the existing data base employed in this study contains numerous unavoidable gaps. Intensive sample surveys have been carried out in Big Smoky Valley (Thomas, 1977), the Reese River Valley (Thomas, 1973, Thomas and Bettinger, 1976), Grass Valley (Clawlow and Rusco, 1972), along a proposed power line in east central Nevada (Fowler et al., 1978), around all springs in the BLM Tonopah District (McGonagle and Waski, 1978), and on portions of Nellis Air Force Range (Bergin, 1979). Nonintensive survey has

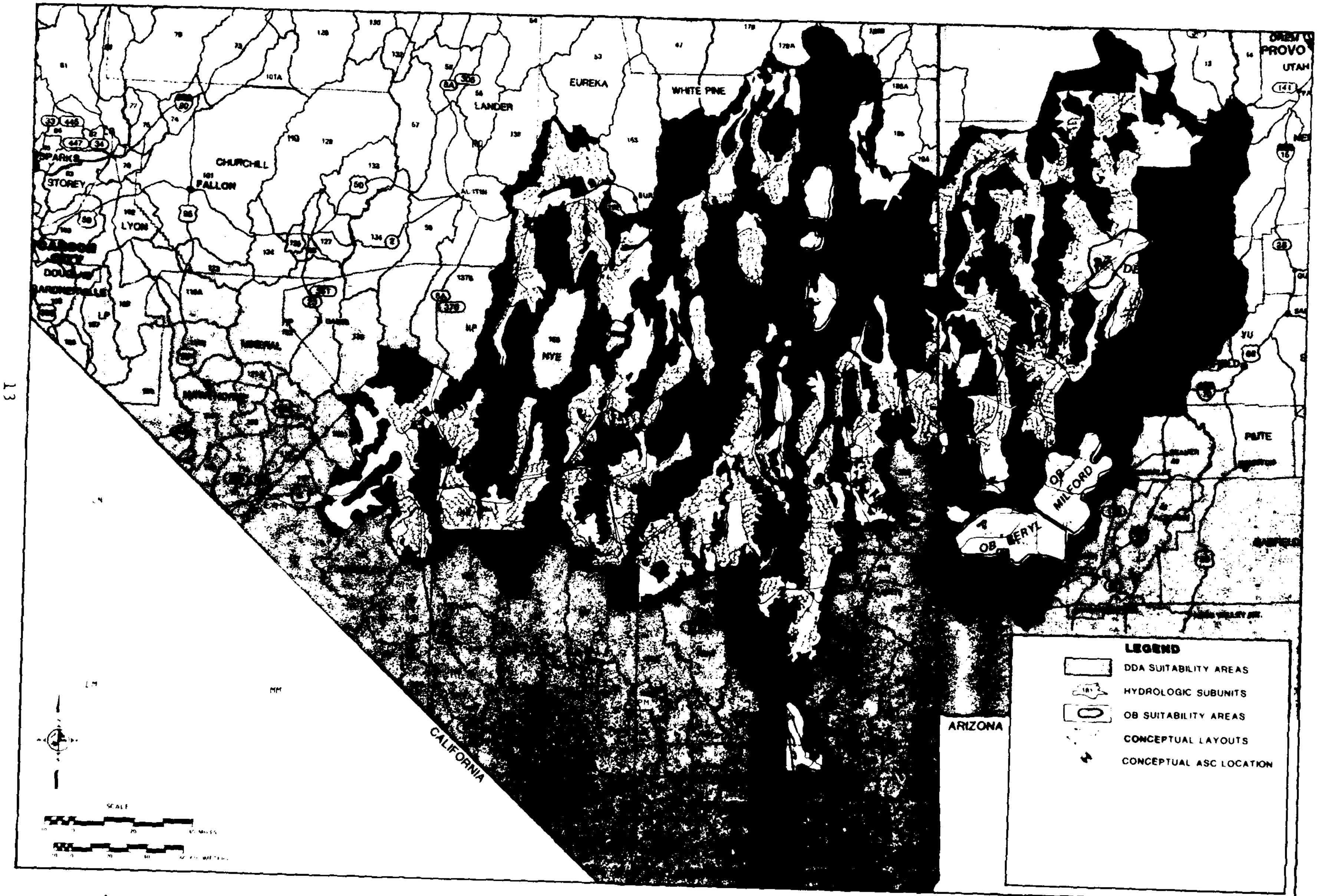

Figure 2.1.-1. Archaeological and historical sites currently listed in the National Register of Historic Places.

Table 2.1-1. Nevada entries in the National Register of Historic Places. (Page 1 of 2)

KEY	NAME	TYPE OF ENTRY	COUNTY
1	Fort Ruby*	Site	White Pine
2	Leonard Rock Shelter*	Archaeological Site	Pershing
3	Austin	District	Lander
4	Berlin	District	Nye
5	Cold Springs	Site	Churchill
6	Grimes Point	Archaeological Site	Churchill
7	Las Vegas Mormon Fort	Site	Clark
8	Fort Schellbourne	Site	White Pine
9	Ward Charcoal Ovens	Site	White Pine
10	Bristol Well	Site	Lincoln
11	Belmont	District	Nye
12	Eureka	District	Eureka
13	Caliente R.R. Depot	Site	Lincoln
14	Aurora	District	Mineral
15	Potosi	Site	Clark
16	James Wild Horse Trap	Site	Nye
17	Tybo Charcoal Ovens	Structures	Nye
18	Tim Springs Petroglyphs	Archaeological Site	Clark
19	Mormon Well Spring	Site	Clark
20	Corn Creek Campsite	Site	Clark
21	Sheep Mountain Range Archaeological District	District	Clark
22	Hidden Forest Cabin	Building	Clark
23	Ruby Valley Pony Express Station	Building	Elko
24	Rhodes Cabin	Building	White Pine
25	Lehaman Orchard and Aqueduct	Site	White Pine
26	Stillwater Marsh	Site	Churchill

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*National Historic Landmark

Table 2.1-1. Nevada entries in the National Register of Historic Places. (Page 2 of 2)

KEY	NAME	TYPE OF ENTRY	COUNTY
27	Black Canyon Petroglyphs	Site	Lincoln
28	Kyle Ranch	Site	Clark
29	Humboldt Cave	Archaeological Site	Churchill
30	Sandstone Ranch	District	Clark
31	Sunshine Locality	Archaeological Site	White Pine
32	Lincoln County Courthouse	Building	Lincoln
33	Cold Springs Pony Express	Site	Churchill
34	White River Narrows Archaeological District	Archaeological Site	Lincoln
35	Rye Patch Archaeological Site	Archaeological Site	Pershing
36	Las Vegas Springs	Site	Clark
37	Applegate-Lassen Trail	District	Humboldt Pershing
38	Sloan Petroglyphs	Archaeological Site	Clark
39	Westside School	Building	Clark
40	Tule Springs	Archaeological Site	Clark
41	Gatecliff Rockshelter	Archaeological Site	Nye
42	Mizpah Hotel	Building	Nye
43	Bunkerville Historic District	District	Clark
44	Pueblo Grande de Nevada	Site	Clark (Lake Mead area)
45	Pine Valley Archaeological District	Archaeological District	Eureka (Pine Valley)

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Table 2.1-2. Utah entries in the National Register of Historic Places. (Page 1 of 3)

KEY	NAME	TYPE OF ENTRY	LOCATION
1	Tintic Mining District Multiple Resource Area	District	Juab (Eureka vicinity)
2	Archaeological Site (No. 42M300)	Archaeological Site	Millard
3	Lang Flat Site (42 In 330)	Site	Iron (Parowan vicinity
4	Booth, Edwin Robert House	Building	Juab (Nephi)
5	Beaver County Courthouse	Building	Beaver County
6	Thomas Farzee House	Building	Beaver County
7	Fort Cameron	Site (buildings)	Beaver
8	Wildhorse Canyon Obsidian Quarry	Site	Beaver
9	George M. Wood House	Building	Iron
10	Old Irontown	Site (buildings)	Iron
11	Gold Spring	Site	Iron
12	Parowan Meetinghouse	Building	Iron
13	Jesse N. Smith House	Building	Iron
14	Parowan Gap Petroglyphs	Archaeological Site	Iron
15	George Carter Whitemore Mansion	Building	Juab
16	Nephi Mounds	Archaeological Site	Juab
17	Cave Fort	Site (building)	Millard
18	Topaz War Relocation Center Site	Site (buildings)	Millard
19	Fort Deseret	Site	Millard
20	Utah Territorial Capitol	Building	Millard
21	Gunnison Massacre Site	Site	Millard
22	Pharo Village	Archaeological Site	Millard
23	Lincoln Highway Bridge	Object	Tooele

Table 2.1-2. Utah entries in the National Register of Historic Places. (Page 2 of 3)

KEY	NAME	TYPE OF ENTRY	LOCATION
24	Iosepa Settlement Cemetery	Site	Tooele (Skull Valley)
25	Benson Mill	Buildings	Tooele (Mill Junction vicinity MTP)
26	Bonneville Salt Flats Race Track	Race Track	Tooele
27	Panger Cave	Archaeological Site	Tooele (NHL)
28	Windover AFB	AFB	Tooele
29	Mountain Meadows Historic Site	Site	Washington
30	Hurricane Canal		Washington
31	Pine Valley Chapel and Tithing Office	Buildings	Washington
32	Deseret Telegraph and Post Office	Buildings	Washington
33	Jacob Hamklin House	Building	Washington
34	Wells Fargo and Co. Express Building	Building	Washington
35	Cable Mountain Draw Works	Buildings	Washington
36	Thomas Judd House	Building	Washington
37	Old Washington County Courthouse	Building	Washington
38	St. George Tabernacle	Buildings	Washington
39	St. George Temple	Building	Washington
40	Brigham Young Winter Home and Office	Buildings	Washington
41	Wallace Blake House	Building	Washington
42	Robert D. Covington House	Building	Washington
43	Washington Cotton Factory	Building	Washington

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Table 2-1-2. Utah entries in the National Register of Historic Places. (Page 3 of 3)

KEY	NAME	TYPE OF ENTRY	LOCATION
44	Fort Pearce	Site	Washington
45	Dr. George Fennemore House	Building	Beaver
46	Duckworth Grinshaw House	Building	Beaver
47	David Muir House	Building	Beaver
48	Harriet S. Sheperd House	Building	Beaver
49	Dennis Charles White House	Building	Beaver

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Table 2.1-3. National Register nominations currently in preparation in the Utah study area.

KEY	NAME	TYPE OF ENTRY	LOCATION
A	Wendover	Site	Toelle County
B	German Village	Site	Toelle County
C	Fish Springs Cave	Archaeological Site	Juab County
D	Paleo-Indian Site	Archaeological Site	Millard County
E	Sand Cliff Signature	Site	Iron County
F	Parowan 3rd Ward	Building	Iron County

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Table 2.1-4. Entries in the Utah State Register. (Page 1 of 2)

KEY	NAME	TYPE OF ENTRY	LOCATION
1	Marcus L. Sheperd Home	Building	Beaver
	Williams Hotel	Building	Beaver
2	George Lamar Wood Cabin	Building	Iron
3	Joseph S. Bunter Home	Building	Iron
4	Old Main and Old Administration Building, Southern Utah State College	Building	Iron
5	UPRR Depot	Building	Iron
6	Median Village	Archaeological Site	Iron
7	Pioneer Iron Works Blast Furnace Site	Site	Iron
8	Parowan Third Ward Meetinghouse	Building	Iron
9	Deseret Chool	Building	Millard
10	Filmore Rock Schoolhouse	Building	Millard
11	Stevens Home, Holden	Building	Millard
12	Edward Partridge Jr. Home	Building	Millard
13	Delta Sugar Factory Warehouse	Building	Millard
14	Delta Sugar Factory Clubhouse	Building	Millard
15	Burtner Dam Ruins, Delta Vicinity	Building	Millard
16	Gunnison Bend Dam and Reservoir, Lower Sevier River	Objects	Millard
17	USRR Bridge across Sevier River	Object	Millard
18	McCullough Log House and Post Office	Buildings	Millard
19	Millard Academy	Building	Millard
20	Woodrow Hall	Building	Millard

Table 2.1-4. Entries in the Utah State Register. (Page 2 of 2)

KEY	NAME	TYPE OF ENTRY	LOCATION
21	Deseret Petrographs	Archaeological Site	Millard
22	Black Rock Springs Petroglyphs	Archaeological Site	Millard
23	Meadow LDS Church	Building	Millard
24	Fillmore American Legion Hall	Building	Millard
25	Ophir Town Hall and Fire Station	Building	Tooele
26	Tooele County Courthouse	Building	Tooele
27	David E. Davis Home	Building	Tooele
28	John Sharp Home	Building	Tooele
29	Naegle Winery	Buildings	Washington
30	Washington Ward Chapel	Building	Washington
31	Fort Harmony-Peter's Leap Historic District	District	Washington
32	Stirling Home	Building	Washington
33	Graftan Church	Building	Washington
34	Peter Nielson Home	Building	Washington
35	Virgin River Drainage Archaeological Area	Archaeological Site	Washington
36	Alexander F. McDonald Home	Building	Washington
37	Cannan Gap Pictographs	Archaeological Site	Washington
38	Bloomington Pictographs	Archaeological Site	Washington
39	Toquerville Church and Relief Society Hall	Buildings	Washington
40	Goldsborough Hotel	Building	Juab
41	Levan LDS Church	Building	Juab

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been completed in east central (Fowler, 1968) and southeastern Nevada (Fowler, Madsen, and Hattori, 1973). Excavations in caves and rock shelters have provided important information on chronology, material culture, and subsistence remains (e.g., Bryan, 1972; Busby, 1977; Busby and Seck, 1977; Fowler, 1968 a, b; Gruhn, 1972; Thomas, 1976; Wheeler, 1973). Several studies of petroglyph sites have also been completed (Heizer and Baumhoff, 1962; T. Thomas, 1976). Most recent work has been in the form of smallscale clearance surveys conducted on BLM lands. These studies have substantially increased the site inventory for Nevada.

Only a limited amount of previous archaeological research has been conducted in western Utah. Major excavations have been completed in two caves in northwestern Utah (Aikens, 1970; Jennings, 1957) and Dalley (1976) has reported on a program of survey and excavation in that area. Intensive samply survey and testing has been conducted in the Deep Creek Mountains (Lindsay and Sargent, 1977; Sargent, 1978) and a sample survey was completed along a proposed transmission line route in west central Utah (Fowler et al., 1978). The BLM implemented a small sample survey in Dugway Valley (Cartwright, 1980) and the Utah Division of State History investigated four caves and an open site in adjacent Fish Springs Valley (Madsen, 1979). Early nonintensive surface surveys were also carried out in western Utah (Anderson, 1962; Malouf, Dibble, and Smith, 1950; Rudy, 1953) and excavations were conducted at the Garrison site, a large open site near the Nevada/Utah border (Taylor, 1954). Small-scale clearance surveys on BLM land have been an important recent source of new archaeological data in Utah as well.

Most synthetic treatments of the prehistory of western Utah have relied principally upon the data from excavations at a limited number of sites (Madsen and Berry, 1975; Madsen, 1979). Due to the general lack of data from large-scale archaeological surveys, reconstruction of regional settlement and subsistence patterns has been hampered.

CULTURAL HISTORY (2.2.2)

Available information serves to document a diversity of past adaptive patterns in central Nevada during the last 11,000 years. The earliest occupants of this area were hunters and gatherers who emphasized use of the resources that occurred in and around Pleistocene lakes and rivers. Climatic change resulted in the drying up of these lakes and rivers, and after 6000 B.C. a more desert-oriented way of life is documented for the study area. Hunting and gathering was still the subsistence mode, but the emphasis was on small game and wild seeds rather than lacustrine resources. In the southeastern portion of the study area some farming and a more sedentary lifeway were practiced during the period between A.D. 400 and 1200. By A.D. 1300 yet another transition had occurred, for by this time Numic speaking groups, perhaps from the southern California area, had expanded to occupy the entire Great Basin area. When Euroamericans first entered the study area in the late 1700s, they found it occupied by Numic speakers who practiced a mobile hunting-gathering lifeway.

Human occupation in western Utah is though to date back to about 8000 B.C. Unlike other areas, there is no current evidence to indicate that the Paleo-Indian hunters of now extinct large mammals ever inhabited Utah. Instead, Archaic hunters and gatherers in Utah may have existed contemporaneously with the Paleo-Indian hunters. A possible explanation is that megafauna were already extinct in the

Great Basin when man arrived (Jennings, 1978). Madsen (1979) however does postulate a Paleo-Indian occupation that focused on hunting of megafauna and collecting of lake periphery resources at 11,000-10,000 B.P. Subsequently, from about 10,000 B.P. to A.D. 400, the only culture represented is the Desert Archaic. These people followed an annual round based on seasonal, scheduled harvesting of both plants and animals. From A.D. 400 to about A.D. 1300, most of Utah was occupied by Fremont peoples with a horticultural subsistence; however, Archaic gathering practices were blended with the new additions of pottery, domesticates, and at least semi-permanent villages. A third cultural group, the Shoshone speakers, entered the study area around A.D. 1200. These people followed lifeway similar to the Archaic pattern of seasonal movement and harvesting of wild food resources. The Fremont seem to have left the area perhaps as the Shoshone people expanded eastward into the region.

The nature of the resources exploited by the past occupants of the study area had a strong determining effect on the nature and distribution of the material remains that now comprise the archaeological record.

KEY RESEARCH PROBLEMS (2.2.3)

The nature of the relationship between key research problems and the environmental impact assessment process requires a brief evaluation. Two principal factors mandate the considereation of research problems. First is the legal requirement that the significance of all historic properties must be evaluated in order to determine whether such properties are eligible for nomination to the National Register of Historic Places. An important significance criteria is the potential "to yield information significant to history or prehistory" (36 CFR 60.6d). Adequate evaluation of this criterion requires a careful consideration of the current status of both scientific method and knowledge of the local and regional setting in which a historic property exists. Second, employment of the most current method and theory has the potential to increase the efficiency of the impact assessment process. This is especially apparent in the present situation where there has been a minimum of previous research within the very large potential impact area that must be evaluated. Use of a mathematically based sampling design in order to develop a data base from which predictions can be made about the nature and distribution of cultural resources in unstudied areas should lead to significant cost savings while ensuring defensible results. In summary, consideration of legal requirements and overall efficiency in the impact assessment process mandates the incorporation of the most current method, theory, and regional knowledge as an integral part of the process.

This is an early phase in the process of evaluating potential impacts of the M-X project on cultural resources, and the principal methods for obtaining new data will be the implementation of a regional sample survey of approximately 100 mi^2 (260 km^2) within the Nevada/Utah study area. Therefore, the research problems considered here are those that are judged most directly relevant to this particular project area and phase. Three broad types of research problems are defined and more specific topics within these categories are discussed. The nature of previous research in these problem areas is briefly reviewed.

Methodological Questions

Two methodological questions of central importance to the present project are considered. First, is the question of using a program of intensive sample survey to evaluate the archaeological resource base of a large region. Binford (1964) was an early advocate of the use of sampling theory for efficiently gathering information about the archaeological resources present within a region. Significant advances in the development or archaeological sampling theory have ensued (e.g., Mueller, 1974, 1975; Plog, 1976), and sample surveys are now commonplace. Within the Great Basin systematic sample surveys have tended to be implemented in a relatively restricted area such as a portion of a valley (Thomas, 1969, 1973) or part of a mountain range (Lindsay and Sargent, 1977), though a large area on Nellis Air Force Range was the study area during a recent project by University of Nevada, Las Vegas (Bergin et al., 1979). The M-X study area significantly exceeds previous Great Basin study areas in size, therefore a phased sampling program has been developed. The initial pahse to be implemented this year, will provide a data base that will allow identification, assessment, and comparison of the subregions that likely exist within this large study area. The principal goals of this initial phase are a preliminary assessment of the nature, density, and distribution of archaeological resources within the entire study area, and the formulation of more sophisticated sampling strata and techniques to allow implementation of a second phase survey that is even more efficient.

A second and closely related problem involves the development of appropriate methods of field observation and data recording in order to minimize the effects of unwanted variability that can arise during the field phase of such a large-scale project. Some methods for controlling this variability are discussed by others (Plog, Plog, and Wait, 1978; Schiffer, Sullivan, and Klinger, 1978), and additional methods have been incorporated into the design of this project. The field recording forms and manual, the conduct of pre-fieldwork orientation sessions on the rationale and procedures for using standardized observational techniques, and controlling for such variability during the analysis pahyse of the project are a few of the methods that were developed to deal with this problem.

Research Problems Specific to the Great Basin

A number of substantive problems that are specific to the Great Basin study region are discussed here and their relevance to this phase of the M-X study is established. A substantive problem that has been the focus of a great deal of recent archaeological research in the Great Basin is the nature of past settlement-subsistence systems and their change through time. Much of this research has drawn heavily on the ethnographic work of Julian Steward (1938). Jennings (1957) used Steward's work and results from his own excavations as principal sources in developing his Desert Culture concept. Thomas (1973), on the other hand, used archaeological data to test the hypothesis that the general settlement-subsistence pattern described by Steward for Reese River Valley was operative in prehistoric times as well. Thomas concluded that such a pattern was indicated archaeologically at least since about 2500 B.C. Other recent work has documented variability in settlement-subsistence patterns in local areas through time (Bettinger, 1977; Madsen and Berry, 1975; O'Connell, 1975) and between regions (Bettinger, 1979). In the southern and eastern portions of the present study area agriculture provided at least part of the subsistence base in late prehistoric times. In the eastern Great Basin the reasons for the shifts from hunting-gathering to partial dependence on cultigens and then back to hunting-gathering is poorly understood. A number of hypotheses and proposed approaches to this problem continue to be discussed (Adovasio, 1978; Aikens, 1979; Madsen, 1979; Marwitt, 1979; Winter, 1977). The implementation of a large scale regional sampling program within the M-X study area will contribute significantly to the development of a data base that will facilitate the evaluation of existing hypotheses regarding settlement-subsistence systems as well as the formulation of new hypotheses. As our understanding of past settlement-subsistence systems increases our ability to evaluate the significance of sites as well as to predict the general locations where particular types of sites can be expected to occur should also increase.

A question that has received much attention by Great Basin anthropologists and that can be expected to be of particular interest to Native American groups is the question of Shoshonean origins. In the past, this question has been addressed primarily from a linguistic perspective with most interpretations favoring an expansion from the Death Valley area out into the Great Basin around A.D. 1000 (e.g. Fowler, 1972; Goss, 1968; Miller, 1966). An alternative argument favor in situ development of Great Basin linguistic groups has recently been proposed, however (Goss, 1978) Madsen (1975) is one of the few researchers to address this problem with archaeological data as the principal line of evidence. The present project should provide an expanded archaeological data base that should allow further exploration of this problem from an archaeological perspective.

Several research questions are considered in relation to the artifact collection policy that is proposed for this field study. Much previous research in the Great Basin has been directed at defining artifact typologies and establishing the temporal significance of the types. For the regional field survey that will be encountering primarily open sites, projectile points (eg., Heizer and Hester, 1978; Holmer, 1978; Thomas, 1970) and pottery (eg., Baldwin, 1950; Madsen, 1977) will be the first artifacts that are temporal, most sensitive and most likely to be discovered. To document the probable time of occupation of sites, and because projectile points and pottery are likely to be collected by unauthorized persons, it is proposed that all projectile points and a small representative sample of pottery be collected from sites when they occur on the surface. For the second phase of survey it is proposed that as systematic sample of obsidian artifacts be collected from sites where they occur and that samples be collected from obsidian source areas should they be encountered during the course of fieldwork. Obsidian artifacts have the potential for being traced to a particular source area through neutron activation analysis, and through obsidian hydration studies there is the potential to date such artifacts. The potential for documenting past obsidian exchange systems has been well documented elsewhere (Pires-Ferreira, 1976; Wright, 1969) and is a highly appropriate research problem for a large regional study in the Great Basin where obsidian sources occur and obsidian artifacts are widely distributed. The potential for refining chronological inferences by means of obsidian hydration studies is also promising.

General Anthropological Questions

Recently a great deal of attention has been directed toward developing predictive models regarding hunter-gatherer settlement-subsistence systems (e.g., Jochim, 1976; Keene, 1979, Perlman, 1976; Winterhalder, 1977). Such models do not require archaeological data to generate predicted archaeological patterns, rather they utilize general principles drawn from the ethnographic literature or employ principles such as economic optimization or optimal foraging to generate these predictions. The present project provides an opportunity for refinement of such modeling techniques. The concommitant implementation of a large scale regional survey will provide a regional data base with which to evaluate the accuracy of the predictions of these models. Use of the model to help structure field surveys has the potential of greatly increasing the efficiency of the field survey program. A predictive model based on behavioral principles would also have utility in evaluating the significance of the archaeological resources present in the study area.

EXISTING DATA REVIEW (2.2.4)

This section consists of three subsections. First the existing data is described and some of the biases inherent in it are evaluated. Then the inventory of archaeological sites from some 77 hydrologic subunits in the Nevada/Utah are used to explore regional level patterns in the existing data base. The third section uses only a portion of the existing data in order to make some preliminary evaluations of site density and distribution in a portion of the study region. These data are from a regional sample survey conducted recently on Nellis Air Force Range. This was the largest systematic sample to have been conducted in the Great Basin prior to the M-X regional sample survey of Summer 1980, and thus represents an especially valuable data base.

The Archaeological Data Base (2.2.4.1)

The principal data sources for the discussion that follows have been the existing site records on file with the Nevada State Museum, the Archaeological Research Center of the University of Nevada, Las Vegas, the Desert Research Institute, and the Utah Division of State History. Some additional data have been obtained from BLM offices in Tonopah, Ely, and Las Vegas, although a complete search of all site records on file at BLM offices has not been completed. Published and unpublished reports on surveys and excavations serve to supplement the site records.

The study area under consideration here includes watersheds within Nevada/Utah (Figure 2.2.4.1-1). This study area includes all valleys that are part of the Dedicated Deployment Area (DDA) for the Proposed Action, as well as additional adjacent valleys. Inclusion of these additional valleys helps ensure that baseline conditions in potential indirect, as well as direct, impact areas are considered.

There is a great deal of variation in the quantity and quality of information recorded on existing site forms. To some extent this is due to the long time span over which site records were completed for the earliest form from this study area is dated 1922. Since that time many different archaeologists have used a series of different site forms to record information of sites they encountered. Variations in their skills, interests, and diligence in completing forms is clearly observable in the records on the 1957 sites that form the data base from this study area. In recent years there has been a movement toward standardization of forms. A wider range of information is elicited by these forms, and there are generally fewer sections that the field archaeologist has left blank.

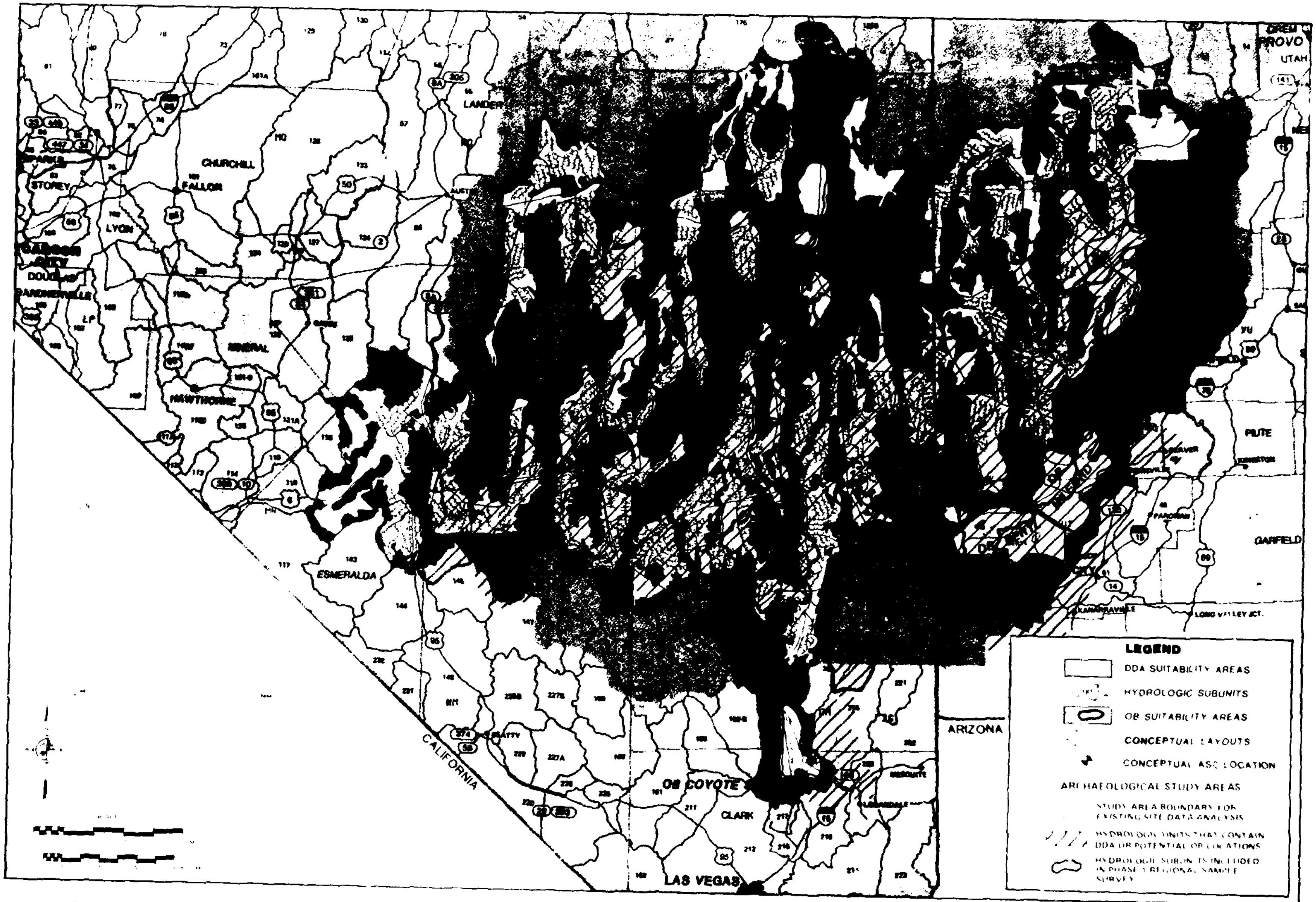

Figure 2.2.4.1-1. Area boundaries considered for archaeological and historical resources in the Nevada/Utah study area.

Date Coding Procedures

Because of the high degree of variability in the amount and quality of the information recorded on site forms over the years, only a limited number of variables were selected for coding. The final set of variables employed fall into three categories: administration, locational, and site attributes. Administrative variables consist of such things as site number, National Register status, and BLM district. Locational variables include Universal Transverse Mercator (UTM) coordinates, and information about the topographic setting and landform on which a site is located and its relationship to permanent water. The above information is either readily available on the site forms themselves or is relatively easily obtainable from maps, thus the accuracy of this information is good. One limitation on the accuracy of these data is the map scale of 1:250,000 which was employed throughout this phase of the project. Given the very large study area, the large number of known archaeological sites, and the preliminary nature of this work with existing site records, working at a larger map scale was not justifiable. The final set of variables, those recorded on site attributes, are the ones that posed the greatest problems for accurate data coding. Many times forms do not contain adequate detail to allow variables of potential interest to archaeologists to be coded, and other times there is a strong likelihood that different coders will interpret the same information in different ways. These problems were dealt with in two ways. First, the number of variables coded was reduced to the following: Site type, site subtype, cultural affiliation, period of occupation, site area, site condition, type of survey, and the date the site was recorded. Since the variable "site type" plays an important role in the discussion that follows, the criteria employed in inferring this variable from the information on site forms is briefly reviewed.

The typology that was employed here was intentionally a very simple one, but it was constructed so as to have relevance to past behavior. The categories include "Multiple Activity Sites," "Special Activity Sites," Limited Activity Sites," and "Isolated Artifacts." The category "Special Activity" refers to such sites as petroglyphs, pictographs, or burial sites, and these are generally easily inferred from site forms. Isolated artifacts are also easily identifiable from site forms because they consist of only one, or sometimes a very few, artifact and they are generally recorded on a special short form. Thus the principal difficulty faced by a data encoder is the distinction between "Multiple Activity" and "Limited Activity" sites. It should be noted that the typology employed here is conceptualized as representing a continuum as to the amount of time of occupation and the diversity of activities performed at a site. Thus Isolated Artifacts are assumed to represent a brief episode of past human behavior consisting of a single or very few types of activities. Length of occupation and diversity of activities increases at Limited Activity sites and is greatest at Multiple Activity sites. Special Activity sites are not assumed to fall at any particular place along this continuum, and must be considered separately if behavioral inferences are attempted.

The following criteria were used to distinguish between Multiple and Limited Activity sites: site size, density of cultural material, and diversity of cultural material. These criteria were evaluated individually and then the interactive effects of all of them were considered in making the final decision regarding the appropriate site category. The site size threshold for Multiple Activity sites tended to be around 10,000 m^2. Diversity of cultural materials was based primarily on the presence of ground stone or pottery because those items were most frequently mentioned, but numerous hearths or the presence of diverse chipped stone tool types were other significant criteria. Density of materials was frequently not precisely stated by the field recorder and had to be inferred from qualitative statements made by that individual or had to be excluded as a decision-making criterion. When considering all of these criteria together the following general approach was taken. Limited activity sites tend to be small and/or light scatters of flakes with very few or no tools or potsherds, no groundstone, and at most one or two hearths, but they may also be extremely large flake scatters with only a few other artifact types present. Sites with greater density and diversity of cultural materials and greater size than indicated above would be classified as Multiple Activity sites. To minimize variation introduced by different encoders applying these criteria in different ways, all encoding of site attributes was done by a single individual who has had previous field experience in Nevada. The result of the above procedures has been to create a data base that is roughly equivalent for the entire region of the study area and that is based on general behavioral principles.

Evaluation of the Data Base

There are two types of bias that might be expected to occur in a data base of this sort that can be evaluated with currently available information. First is bias introduced by the passage of a significant amount of time since a site was originally recorded. The observations of early observors would not have the benefit of information accumulated in more recent times, and they certainly would be inadequate for evaluating the current condition of a site. It has also been noted that early site forms do not contain the same level of detailed observations about a site that is characteristic of more recent forms. Fortunately, a significant percentage of the sites included in the present sample have been recorded in recent times while the first site in our sample was recorded in 1922. Figure 2.2.4.1-2 shows graphically the dramatic increase in the rate of recording of archaeological sites that has taken place recently. In fact fully 75 percent of the sites in our sample have been recorded since 1967. As a result, the potential problem of bias that results from old data is substantially lower that what might be expected from a data base that has accumulated over so many years.

A second potential problem in this regional data base is bias in the kinds of sites recorded by archaeologists. For example, it is a relatively well-established generalization that earlier in this century archaeologists tended to record only those sites that were large, had diverse and abundant remains, and were easily visible and accessible. Such a bias is clearly detectable in the present data base. Figure 2.2.4.1-3 allows a comparison of the rates at which different types of archaeological sites have been recorded over time. It is evident that prior to 1960 archaeologists focused primarily on Multiple Activity (MA) and Special Activity (SA) sites in their field studies. Interestingly, there is a similar rate of recording these two site types right up to the present, with slightly over four MA sites being recorded for every one SA site for most of the five year periods since 1930. Limited Activity (LA) sites are very clearly underrepresented in the sites recorded before 1955. Prior to that time nearly two MA sites were recorded for every one LA site, but after 1955, the relationship is dramatically reversed with more LA sites being recorded. The average for the 25 year period from 1955 to 1979 is three LA sites recorded for every one MA site. Isolated Artifacts (IA) have by far the most biased representation in the current sample. Almost no IAs were recorded in Nevada prior to 1975, and it still is the policy in the state of Utah not to prepare site forms in IAs.

The information on IAs provided by the current sample is too biased to be very informative on a regional level. Furthermore this bias clearly is the result of the very different site recording policies that are employed by Nevada and Utah.

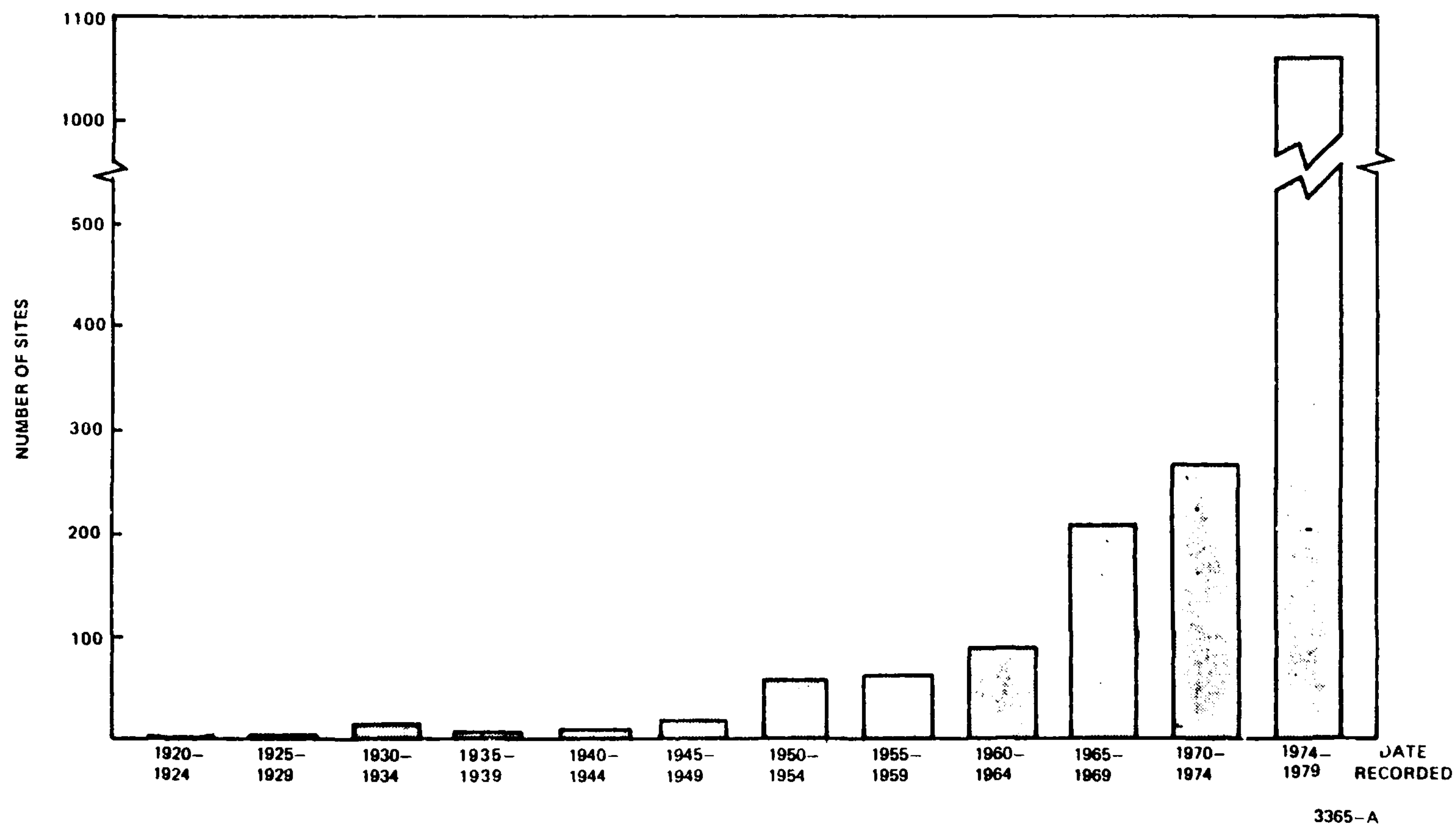

Figure 2.2.4.1-2. Number of archaeological sites recorded in each five-year period since 1920 within the Nevada/Utah study region.

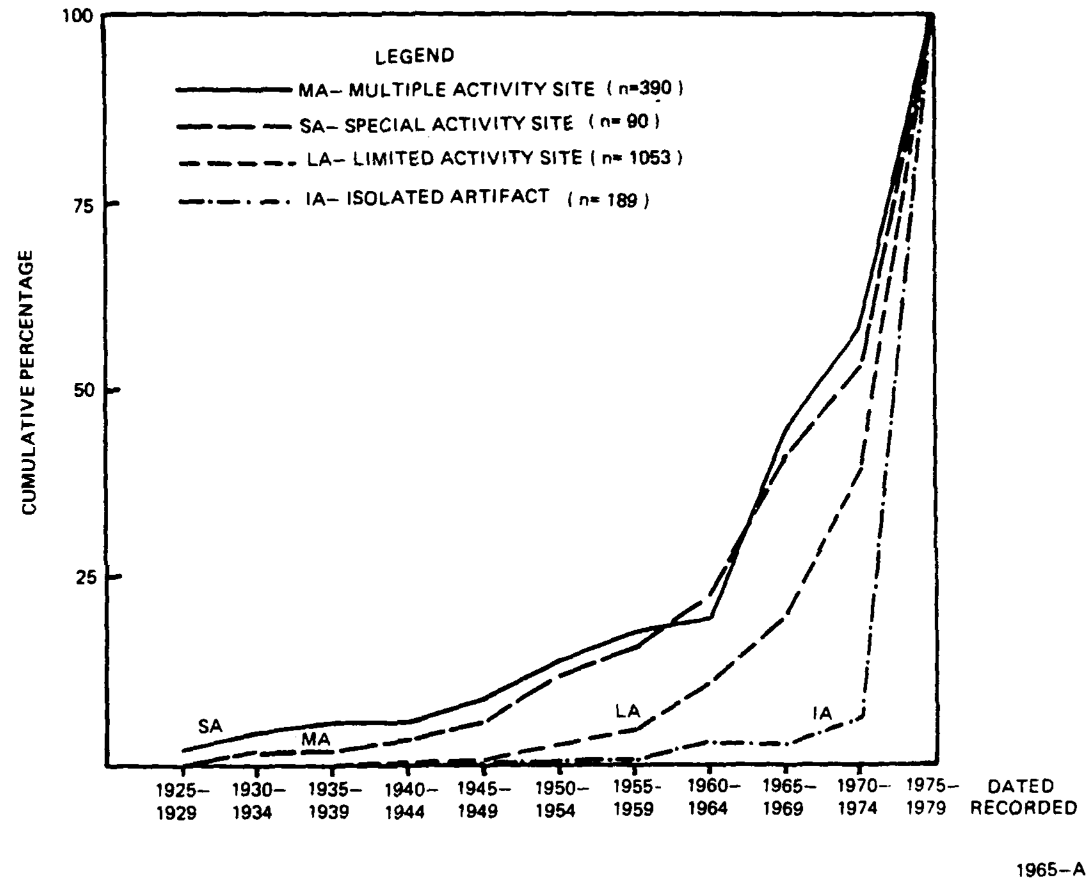

Figure 2.2.4.1-3. Cumulative percentages of sites recorded by five-year periods for four archaeological site types.

Therefore IAs are not considered further in this exploration of causes and effects of bias in the current sample.

It would appear from the preceding discussion that the greatest potential bias in the present sample is in the differential policies applied by archaeologists to the recording of Limited Activity sites. When coding the present site data information regarding the type of survey that was employed to discover the site was recorded where possible. The three survey types identified were as follows:

- o Nonsystematic - any survey that did not employ a specific, statistically based sampling design and did not cover 100 percent of the area investigated.
- o Systematic Sample - some of the surveys in this category employed explicit, statistically based sampling designs, while others selected sample units according to explicit, consistent criteria believed to be related to site location (e.g. in the BLM Tonopah Resource Area, all springs were surveyed). Intensive survey techniques were employed within the sample units selected.
- o 100 Percent Intensive - generally these are clearance surveys done as part of the environmental assessment process for land modification projects. Survey location is most often determined by the requirements of the project, and intensive survey techniques are generally employed over the entire project area.

It is not possible presently to evaluate how much land area within the study area has been surveyed by each of the above techniques. It is possible to indirectly assess whether different topographic zones have been differentially sampled by these three survey techniques and whether there is evidence of bias in the site recording practices employed. The procedure used here is to examine two sets of figures: the total number of sites (MA and LA sites only) recorded in each topographic zone by the different survey strategies, and the ratio of LA to MA sites recorded (Table 2.2.4.1-1). Several interesting patterns are suggested by this table. First, it is clear that the 100 percent intensive surveys (Type C) are recording a much higher frequency of LA sites, with the Nonsystematic surveys (Type A) recording the fewest LA sites. It is especially interesting to examine the individual topographic zones for variation. If we assume that the number of sites recorded in each topographic zone is a rough index of the amount of survey that was conducted in that zone, then the following conclusions can be drawn for each zone.

- o Mountain - This is the only zone where there is rough equivalence in the LA:MA ratios obtained by all three survey types. It appears that Type C is the dominant type of survey in this area. Given that over one-third of all sites in our sample are from the mountain zone and that there is close agreement between the results of all three survey types, the mountain zone data would appear to have a high likelihood of being representative.
- o Upper Bajada - While roughly equivalent numbers of sites have been recorded by the three survey methods, there is great variation in the ratio of LA to MA sites recorded. It would appear that LA sites were being systematically ignored by Type A surveys in the upper bajada zone.
- o Lower Bajada - Again there is great variation in the ratio of LA to MA sites recorded by the three survey types. It appears that Type A survey was rarely conducted in the lower bajada zone, and when it was, MA sites were strongly emphasized. This is the type of situation that might be expected to result if local informants were being used as sources of leads regarding site locations.

Table 2.2.4.1-1. The ratio of limited activity sites to multiple activity sites (LA:MA) recorded by three different survey types.

SURVEY TYPE	TOPOGRAPHIC ZONE				
	MOUNTAIN	UPPER BAJADA	LOWER BAJADA	VALLEY FLOOR	TOTAL
A. Nonsystematic	2.8:1 (92)[1]	1:1.4 (67)	1:1.6 (18)	1.7:1 (24)	1.4:1 (201)
B. Systematic Sample	2.4:1 (94)	3.8:1 (67)	2.8:1 (53)	1.8:1 (141)	2.3:1 (355)
C. 100 Percent Intensive	3:1 (162)	12:1 (78)	16:1 (52)	6.4:1 (81)	5.2:1 (373)

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[1]Figures in parentheses are the total number of sites recorded (LA + MA).

- Playa/Valley Floor - In this zone Type B survey has been the most common, with Type A the least common. Interestingly, both survey types have resulted in almost exactly same LA to MA ratios. However, Type C surveys resulted in a LA to MA ratio over three times higher.

The differences in LA to MA ratios noted above are probably best explained as the result of the choices made by archaeologists regarding where to survey that is possible in both Type A and B surveys. Type A surveys allow the archaeologist to choose both the general and the specific areas in which to search for sites. Most Type B surveys allow the archaeologist to choose a general area in which to survey with specific sample units chosen by random or other means.

On the other hand Type C surveys allow for little or no input by the archaeologist as to where survey is to be done. Furthermore, the archaeologist is responsible for recording all evidence of cultural remains within that study area. With the apparent exception of the Mountain zone, then, the differential results obtained by the different survey strategies would appear to be explainable in two parts. First, the strong contrast noted between Types A and B and Type C would appear to be the effect of archaeologists choosing places of known (or at least expected) high abundance of MA sites as locations to conduct either a Type A or B survey. On the other hand Type C surveys have been conducted in a much broader range of settings. The result has been a much lower frequency of MA sites recorded relative to LA sites. This is not unexpectable, for MA sites are apparently less frequent than LA sites overall and furthermore they tend to distribute in a clustered rather than a uniform or random pattern over space. On a regional scale Type C surveys could be conceived as random surveys with very small sampling fractions. Because it is known that sampling is not a very effective method for the discovery of rare elements, it is not surprising that the LA to MA ratio of the Type C survey is high relative to the other survey types.

The second factor that appears to account for the differential results obtained by the three survey methods is believed to be observer bias. While Type B was noted as sharing a similar study area selection process with Type A surveys, Types B and C employ comparable methods of ground inspection once in the field. That is both attempt to record all cultural remains encountered. It is for the Upper Bajada Zone that there is the clearest evidence of systematic bias in the results obtained by Type A surveys. Based on the arguments presented above, the principal factor accounting for differences in the LA:MA ratio between survey types A and B in the Upper Bajada should be field examination and recording technique. Thus it would appear that there was a strong bias against searching for and/or recording of LA sites during Type A surveys in this zone. This point gains significance because of the large number of sites for which survey type could not be reliably determined from the site form during the data encoding process. These "indeterminate" survey types comprise over half of the total sample of sites and many may have been recorded by Type A surveys.

These sites are considered briefly to determine if they may be introducing a significant bias into the overall sample. The LA:MA ratios by topographic zone are as follows: Mountain--2.4:1 (146 sites), Upper Bajada--2.6:1 (144 sites), Lower Bajada--3.2:1 (114 sites), Valley Floor-2.2:1 (167 sites), Total--2.5:1 (571 sites). It is immediately apparent that for each topographic zone the LA:MA ratios for the sites whose survey type was indeterminate very closely resemble the ratios for systematic sample surveys (Table 2.2.4.1-1. Thus this set of indeterminate sites probably does not introduce a significant additional bias to the sample of sites used in this analysis.

A potential source of bias that has not yet been evaluated is whether there are any major differences over space in the kinds of surveys that have been conducted. For example, if only Type A surveys have been conducted in a contiguous set of hydrologic subunits, then it is conceivable that LA sites would be significantly underrepresented in that region. Because the patterns that are being considered in this analysis are on a very large spatial scale, it is unlikely that such a situation would arise. However, work presently underway will attempt to evaluate this and other factors that may represent significant bias in the data base.

Global Features of the Spatial Distribution of Great Basin Sites in the M-X Project Area (2.2.4.2)

Introduction

The data that are being obtained through the several sampling stages of the survey of cultural resources in the impact area for the M-X Project, in conjunction with the previously collected data from the project region, form a data base of unique character and enormous scientific value for the study of prehistoric societies in this region. This data base, with an overall spatial scale for the distribution of sites equal to, or greater than, the spatial scale of the societies represented represented therein, creates the potential for a pan-societal study, perhaps for the first time in the archaeology of this or any other region. The data being accumulated under the scope of a single project has the potential for serving as a rich reference source for scholars involved in virtually any phase of archaeological studies in the Great Basin.

The 2,000 or so sites identified from previous research in the project region can aid in establishing broad patterns of the use of space by whole social/cultural systems as represented through settlement locations. The pattern of concern is that preserved through site locations as representing the loci of activities--settlements--in space and through time by the prehistoric inhabitants of the region. Identification and analysis of systems of spatial use at the level of whole societies is a significant advance in the study of settlement patterns in archaeology. Most research into spatial patterns and subsequent inference about the properties of the system generating that pattern of settlement location have been limited to a portion of the whole system of settlements. While these studies (e.g. Hodder 1979) have made significant advances with respect to clarifying the relationship between settlement pattern and societal system, they are nonetheless limited by only examining a portion of the total system of usage of geographical space. As will be argued below, the collection of extant sites in the project region is quite likely the record of a substantial portion of prehistoric settlements in the project region. The size of the region--some 60,000 square miles for the 70 odd valleys making up the total project area--is sufficiently large to encompass what were perhaps several contemporaneous, distinct former societies. These two observations justify the assertion that this project can initiate the comprehensive archaeological study of whole systems, and even comparison of differences amoung such systems at a comprehensive level.

In this report some of the global properties of the spatial distribution of sites in the region will be examined. The theme is description of spatial distributions in terms that are indicative of global subsistance patterns, societal divisions and spatial distribution of groups of persons living together for day-to-day activities and making up the set of all persons who occupied this region in prehistoric times.

This type of study--based on a large scale regional data base--is both complementary to present and past research in the Great Basin and has the potential for resolving issues that need a pan-regional perspective for resolution. It also requires a shift of focus from emphasizing a few sites with unusually rich deposits of artifactual material to examining the extremely large number of comparatively mundane sites which in fact make up the whole settlement pattern of these past societies. At the same time, new approaches to data recovery and analysis will be required. The sheer number of sites that will eventually come under the scope of this project overwhelms traditional approaches based on examining in detail a few, select sites. This report will also give, in part, steps that are being taken towards resolution of some of these difficulties.

The Present Data Base

A search of published reports on previous archaeological work in the region has yielded over 2,000 sites. These reports are the result of more than 50 years of research in the Great Basin and represent a wide variety of research goals, methods of data recovery and consistency of effort. Sites have been recorded for reasons ranging from fortuitous knowledge to systematic study. In the last several years, contract archaeology has introduced a variety of restricted sampling schemes, typically involving long transects along various proposed rights of way. Systematic studies of localities in the area using statistical sampling techniques are, however, virtually nonexistent. The nature, amount and care with which information has been recorded on individual sites is highly inconsistent and even the kind of sites that have been recorded is uneven. Isolated finds have been recorded in Nevada, for example, but not in Utah.

As a data base, this collection of sites leaves much to be desired. The only measures that can be consistently recorded across all sites give but minimal information about particular sites and what they represent about past societies. Data are virtually nonexistent beyond the most gross of time periods. There is virtually no information on whether local areas were examined extensively, or only on a judgmental basis (if even that).

What little data can be consistently obtained across sites is clearly insufficient for making anything requiring a fine scale of measurement. It is not possible to assign seasonality, type of activity, length of a single occupation or number of years of occupation to these sites, even allowing for wide ranging margins of error.

While lack of consistency in what is to be recorded on sites is part of the difficulty, the main problem is not knowing what should be recorded, even assuming that such data are feasible to obtain. It is easy to note the lack of information about, say, quantities of artifacts in various artifact classes, but is not clear that knowing there are so many retouched flakes, so many bifaces, so many projectile points, and so on, will substantially change what can be inferred about past systems. The matter runs much deeper than just quantification of types of artifacts. A classification is both limiting and informative. It is informative through making explicit the meaningful divisions in the total assemblage of artifactual material, but limiting in that once the classes are established, artifact data are reduced to membership in classes. If the set of classes is inadequate, then there will automatically be equal restriction on the "fineness" with which classes as units will measure aspects of past systems. Yet it is the latter which is a primary goal of artifact classification. Artifact classes are the units through which aspects of past systems are to be "measured." It is evident that both what should be measured over a site (see, e.g., Read, 1977) and what be artifact classes (see, e.g., Read, 1980) are inadequately specified. Both of these issues need substantial rethinking and reformulation of standard methods. This task, however, is outside the scope of this report.

Previous Research Foci

These sites, or at least a subset of them, have generally been analyzed with regard to: (1) chronological sequences (e.g., projectile point type sequences), (2) "cultural" sequences as manifested by differences in types of artifactual material, and (3) reconstruction of settlement/subsistence systems using, for the most part, the cultural ecological framework of Julian Steward. Data for such studies have generally been a relatively few, selected sites, for sites in a relatively few localities. This perspective has lead to establishing a variety of local cultural sequences by researchers working in limited areas. These local cultural sequences are not necessarily differentiated one from the other because of demonstrated cultural boundaries. Rather, they may simply be so distinguished by the geographical accident of where research has taken place. Ford's objections in the Ford-Spaulding debate over the reality of types may very well be a propos here. In Heister's (1977) review of Great Basin prehistory, one finds some 30 odd sites as representing the Western Great Basin, and 60 sites the Eastern Great Basin. Yet there are literally hundreds of thousands of sites in that same region. To assume that these sites, selected for this unusual characteristics, can be representative of the full variety of sites and factors structuring settlement locations over the whole region.

Thus a different viewpoint is required, namely that of seeing a region from the vantage point of the totality of site in the region. From the viewpoint of the individual site with a rich deposit, the isolated type of site with but one artifact seems to be an unimportant and insignificant find - perhaps the chance occurrence of a passing family or group. And from the viewpoint of the kind of question one tries to answer with the deeply stratified site, indeed it is insignificant. But from a different viewpoint, that of the site as built up from the repeated usage of the same area, year after year, the isolate changes from an unimportant chance occurrence to representing, perhaps, a single camp. It thus serves to identify the location of a group of persons during the yearly round of resource exploitation. If the isolate is not a chance event, it is part and parcel of the whole system of settlements and thus part of the domain to be studied. It poses the question of why there should be but a single short temporary occupation at that place and not the substantial collection of material sometimes taken to define a site.

The isolated find raises to the surface a matter that has tended to be shunted aside or considered superficially. Namely, what amount of cultural debris constitutes a site? A corollary to this question is what does the site actually measure? By traditional definition the site is the spatial locus of cultural debris--artifactual material—with varying notions regarding how much material there must be to constitute a site. Implicit in this definition is the presumption that a site will be dense in artifactual material over an area in equal proportion to the area as used at time of occupation. Hence the treatment of the isolate as an insignificant find. Yet when one asks the question of how much artifactual material will be discarded by one camp in one season of unoccupation, an immediate discord can be seen between the implicit assumption and reality. A camp consists of probably 30 - 40 persons, including children; thus perhaps 6 families. If each family were to discard anywhere from 1 - 10 artifacts per family per season, there would be between 6 and 60 discarded artifacts in one season of occupation. This camp would use some 500 square meters of living space for the whole camp (based on data on San camps from the Northwestern Kalahari Desert), yielding a density around 0.01 to 0.1 artifacts per square meter. Taking into consideration disturbances of various kinds that affect what is initially deposited and what can eventually be found by the archaeologist, it is likely that the density of surface remains would be at the lower end of this range. Thus a surface density on the order of 0.01 to 0.05 artifacts per square meter may not be unreasonable for the debris discarded by the typical 30 occupants of a camp over one season. This translates into about 1 artifact per 20 to 100 square meters. Yet frequently a site is defined by requiring that there be a density on the order of several artifacts per square meter, and possibly several contiguous meters with artifact deposition. In other words, it is defined by requiring a density almost 2 orders of magnitude larger than what is reasonable to expect on the basis of a season of occupation. This suggests that what is called an isolate may in fact represent a single season of occupation by a camp, rather than a chance occurrence, and what has been called a site only identifies a portion of the settlements that have left behind cultural remains which identify their past existence. If the intent of identifying a location as a site is to identify the location of a past settlement, it is presumed in this report, the arbitrary definitions of sites based on quantity of material remains are unjustified. Rather, the presence of cultural debris of any quantity suggests the presence of a settlement as a group of persons of whatever number living together in the same place for some period of time. In specific cases there may be evidence that the remains do not correspond to a settlement, such as would arise if, say the material remains are the result of butchering an animal at that location but the butchered animal has been taken to a settlement at a different location.

Consider next the variation that exists in the area of the sites. As mentioned, the camp of 30 persons may be expected to use about 500 square meters of living space. In fact, sites in the present data set are reported to have surface areas ranging from a few square meters to over a million square meters. Sites with tens of thousands of square meters are quite common in this collection. There are two plausible interpretations for the presence of these large sites: (1) in fact there are settlements with upwards of several hundred persons living together over long periods of time as part of the general pattern of aggregations of persons (which is contradictory to both ethnographic data on this area and on the size of typical camps during the yearly round for foraging groups in general, or else (2) there has been repeated reoccupation of the same general area until a more or less continuous distribution of material remains has been formed leading to the appearance of a single settlement of large area. Thus a site of, say, 50,000 square meters may be the equivalent of hundreds of small settlements on the order of hundreds of square meters of living area and tens of artifacts deposited per season of occupation. If this argument is correct, the notion of the "date" for such a site almost becomes meaningless. Instead there must be reconstruction of the history of the development of the site as the result of having repeated, small settlements in the same locality.

Similar, rough estimates of the total number of camps or settlements in the region can also be made. Studies on foraging groups suggest that a population density on the order of 1 person per 25 square miles to 1 person per 10 square miles is probably correct to an order of magnitude for a region such as the Great Basin. For the 60,000 square miles of the project region, this yields an overall population size between 2,400 and 6,000 persons in any year. Typically a foraging group is divided into camps of some 30 persons. (This seems to be a common average figure. Actual camp size will vary during the yearly round of foraging activities in accordance with the density, predictability and variety of resources.) Thus there should be on the order of 80 to 200 camps being occupied per year in the region if a camp were occupied year round. Camps will not be occupied year round, but represent at least a division into summer and winter camps, and quite likely an even finer division of the year. Assume that there are 2 - 4 camps per group per year. Thus one expects on the order of 300 to 800 camps being established per year over the whole region. In the 3,500 years represented by the Medithermal (which is the time period for most of the sites), there should be a total of 600,000 to 1,000,000 camps. This leads to a total settlement density of from 10 settlements per square mile to about 15 settlements per square mile.

If we assume that a large site represents, on the average, about 20 years of accumulation of material, and there are about 5 - 20 small sites for each large site, then the collection of settlements should translate into about 12,000 to 20,000 large sites and from 60,000 to 400,000 small sites, respectively. This yields an overall site density of about 1.2 - 7 sites per square mile. In terms of small sites, there would be about 1.3 to 6.7 sites/square mile and for large sites, about 0.2 to 0.3 sites/square mile, respectively.

Three estimates of site density can be compared to those realized during the first stage of sampling. The total density figure estimated above can be compared to the density estimated from the 612 prehistoric sites found in 543 sampling units for an average of 9 sites/square mile, with isolated sites included, or 292 sites in 543 units for a density of 4 sites/square mile without isolated sites. (A breakdown on large and small sites for the first stage of sampling is not yet available.) Even considering that the total number of sites found in Stage I sampling may be somewhat biased upwards by the definition of Stratum A as localities with an a priori greater expected likelihood of having sites, there is a remarkable congruence between the two estimates, one based on theoretical arguments and the other determined empirically. These data, taken together, suggest that the totality of sites in the region may very well represent a substantial portion of all settlements that occurred in this region. Further these data indicate that it is plausible to view different site sizes and quantities of artifacts as representing different time spans of occupation by groups of comparable size at time of occupation. Thus the isolate may represent a camp of a few days to a few weeks, a small site a single season of occupation of several months, and larger sites may represent the use of the same locality over tens of years, with some localities perhaps being used for hundreds of years. This still leaves the very largest sites--those of area around hundred thousand to over a million square meters--problematic.

When we consider that a settlement of 30 persons may utilize a living area around 500 - 1,000 square meters at the outside, it is evident that sites on the order of magnitude of 100,000 to 1,000,000 square meters represent extraordinary extremes in the use of space. A camp of 1,000 square meters would require at least 1,000 seasons of repeat use of the same general locality to create a site of 1,000 square meters, assuming no overlap in location of the camp from one season to the next. This seems unlikely. Thus for the largest sites some factor other than repeated use of the same locality by a typical camp must be responsible for the site.

Large scale groupings of persons do occur in foraging societies, even when they are otherwise highly nomadic. Thus the G/wi San of the Central Kalahari will form groups of size about 100 or more persons during the rainly season, while group sizes might only be 10 - 15 persons during the dry season. These large groups may form for periodic ritual purposes (e.g., funerary ceremonies, initiation rites, marriage exchange, and so on). Data on foraging societies indicate that such groupings are not infrequent and mav involve as many as 10 camps, or several hundred persons. In such assemblages of several camps, it is found, at least in some instances, that the camp structure of the separate groups is preserved, so that the area utilized (as determined by a boundary drawn around all of the camps) is considerably larger than just the sum of the areas of the individual camps. An assemblage of 10 camps could thus be spread over some 20 - 50,000 square meters. In such a case, a total area of 1,000,000 square meters would suggest a time frame on the order of 20 - 50 years, assuming the disjoint usage of space from year to year. The latter is unlikely, so that a time frame on the order of 100 years or so is quite likely a lower bound for the largest sites.

These numbers, even though based on crude estimates and assumptions about the nature of groupings of persons, are plausible and consistent with empirical data. This suggests that it would be worthwhile to pursue this type of argument further when better estimates can be made. But regardless of the degree to which this argument captures the details of the facts of prehistoric use of space in the Great Basin, the principle is valid: the larger sites can but represent repeated occupation of the same locality as part of a yearly cycle of shorter and longer occupations by smaller and larger groups of persons during the annual round of foraging activities. This suggests the need to establish plausible factors that have influenced the choice of particular localities for this role of repeated, unusually large aggregations of persons. That, however, is outside of the scope of this report.

Estimated above is the likely existence of some 80 to 200 camps with approximately 30 persons in each camp at any one point in time over the whole region. If all camps are part of a cycle which involves, say, 10 camps aggregating together during part of the year, there would be from 8 to 20 such localities for large aggregations of persons. If each locality represented, say, 200 years, then over the 3,500 years of the Midthermal there should be from 120 to 300 such large aggregations and an equal number of large sites.

The present data set, with an unclear relationship to the totality of sites in the region, has around 6 sites with area reported as 1,000,000 + square meters (4 of these are multiple activity sites, 2 are limited activity sites). The 2,000 sites in the data set are estimated to be about 1/100 to 1/200 of the total number of sites in the region. If they are representative of that total collection of sites, then there would be from 600 to 1,200 extremely large sites. However, given that the largest sites are more likely to be discovered or known about and thus investigated than the more common small site, it is not unlikely that the estimates of extremely large sites are substantially too large. If so, then again these crude estimates are in substantial agreement.

The above argument guides the following first typology of sites with respect to time frame for use of a given locality. (1) Isolates as representing a single camp using locality for a short period of time, such as from a few days to a few weeks; (2) sites with areas in the tens to hundreds of meters as representing camps with from one to several seasons of repeated occupation of the same locality; (3) sites with area on the order of tens of thousands of square meters representing localities where there has been systematic, repeated use of the locality; (4) sites which are in the hundred of thousands of square meters as localities that could either be reoccupation over along time period, or the result of large aggregations of persons for a few seasons; and (5) sites with areas on the order of a million square meters as representing aggregations of several camps over perhaps several hundred years of reoccupation of the same general locality. (The term camp is used here to cover all settlements, regardless of size, duration, and changes in personnel. During the yearly round, the same set of persons will not always be in the same camp, but may fission for part of the year, regrouping at other times, and some personnel, say, temporarily leave for other camps and personnel from other camps may temporarily migrate in. These changes in personnel are not of concern here, so the term camp is used for whatever may be the set of persons, the size of the group or its longevity.)

Ideally, one would like to examine these sites with regard to detailed analysis of artifactual material on the sites and to make intersite comparisons. This would include both an analysis of the total material remains from each site and a study of the spatial distribution of that material across the sites. One would also like dating of the sites adequate for determining the span of time represented by the site. As it stands, data of these kinds are not available for the present collection of sites.

The other main perspective for analysis of these sites is their overall spatial distribution and consequent association with environmental resources, of whatever kind. Provenance data are available for almost all of these sites and information on the area of the sites is available for the majority of them. Direct information on resources in association with sites is not yet available. The sites have been classified into a minimal typology which distinguishes multiple activity sites, limited activity sites, isolates, and special use sites. Subtypes of these main types have also been formulated, though most of the sites represent but one or two of the subtypes. The region has been topographically subdivided into 5 zones: mountain, upper bajada, lower bajada, valley bottom and playa. A variety of landforms have also been distinguished. These data are available for the majority of the sites. The topographic, and to a lesser extent the landforms, provide an indirect measure of resource availability and so analysis of the spatial distribution of sites by these subdivisions should distinguish some of the more pronounced features of the pattern of site location. The general aim, given the nature of the data base, is to determine qualitative differences in patterns of spatial distribution of sets of sites. These qualitative differences should override the undoubted, but unknown, bias built into this collection of sites by lack of systematic study at a regional level.

There are several goals for the spatial analysis. First, what is the spatial distribution of particular types of sites deemed to be significant for understanding the nature of the social/cultural system represented by these sites? Second, what is the nature of the use of space in general; that is, on a continuum running from uniform to random to clustered, where do these sites, or subsets of these sites, fall? Third, if as one would expect, there tends to be a clustered distribution of sites, at what scale does clustering occur? Here we have several possibilities ranging from clusters of sites only distinguishable at a local level (e.g., several sites in close proximity to each other but isolated from other sites and with the clusters randomly distributed in space) to clusters only distinguishable at the level of the region (e.g., all sites randomly distributed within a few, large subregions with those subregions isolated from one another in terms of site distribution) to a combination of these possibilities (e.g., clustering at the local level with local clusters of sites also clustered at the subregional level). Each of these relates to particular models of group/environment interaction.

Briefly, one can expect that the locality and size of groups of persons (except for the unusually large aggregations that may be primarily responsive to the internal working out of social dynamics) are primarily responding to resource distribution and seasonal abundance, with certain constraints imposed by the social system in terms of what constitutes realizable groups for various task purposes. Thus assumption, of groups of persons spatially located to efficiently take advantage of resource abundance and to avoid resource scarcity, is abundantly demonstrated in the study of subsistance strategies by extant foraging groups and is taken here as the primary factor influencing the general features of both the yearly round of settlement location and relative group size.

This assumption has several implications. First, the number of persons and the repeatedness though time with which a given locality will be utilized is determined by the relative constance and abundance of resources in that locality. Thus permanent sources of water are likely to be repeatedly used through time as a locus for a group (or groups) during dry seasons. Hence, it should be noted that "permanent" need not mean unchanging, but assumes only a substantial time frame (e.g., tens to hundreds of years). Similarly, certain kinds of faunal resources often provide a major source of nourishment; localities offering such resources can be expected to be repeatedly used so long as those major resources are present. Conversely, other resources may have only a very short period of fluoresence in a particular locality, thus leading to relatively little repeated use of that area. And other resources may only be used on a fortuitous basis.

The point being established here is not an exhaustive determination of expectable patterns of utilization of resources at a locality in terms of resource availability at that locality through time, but to indicate that there are expectable patterns of use which are determined in a given year by relative abundance and predictability of resources and through time by changes in the character and quantity of resources in response to changing environmental conditions.

It should be noted that because of the Liebig effect, high abundance of a given resource need not correlate with intensive exploitation of that resource as measured by the percentage of the resource used. Population size is bounded above by the least abundant, critical resource; other resources may be plentiful but the "bottle-neck" of a relatively scarce, critical resource will prevent population size from increasing with more intensive utilization of the abundant resource. The Mongongo nut for the Kung San is a classic example of the problem. Perhaps 1/3 or more of the nut crop is unutilized as it represents an abundance which is not available at times of scarcity of other resources due to the distance of the nut forests from permanent water holes during the dry season.

Consequently, expected patterns of resource utilization as given by frequency of use of a locality are tenuous and require careful consideration of the dynamics interrelating resource location, predictability and abundance of resources, nutritional and other requirements, and group size. Rather than trying to formulate a model of expected resource utilization, it is more profitable to view the matter here from the reverse direction. The spatial distribution of sites represents the consequences of these various factors affecting settlement location. That spatial distribution can be recovered. Then the characteristics of the spatial distribution, e.g., association between resources and patterns of site distribution, overall spatial distribution of types of sites, and so on, can be examined in order to reconstruct the "strategy" that lead to that spatial distribution. This, then, is the guiding framework for the analysis of the spatial distribution of the sites in the data base.

Analysis of Spatial Distribution

That these sites have been obtained through a variety of research projects and other data collection procedures requires that there be new approaches to the analysis of spatial pattern. Basically, the problem posed by this collection of sites is twofold: (1) While any given investigator may have been reasonably consistent within an area of study, it is likely that there is consistency over the whole project area and (2) Within a single area, virtually no data are available on the totality of sites that are in any specified locaility; thus, lack of sites from the data base in a spatial unit, however defined, need not indicate that in fact there are no sites at that locality.

The incompleteness of information on site location has been resolved for this study through using a modified Poisson Distribution in which the number of spatial units without sites is generated with frequency that represents what would have been the case if in fact there were a random distribution of the sites in nonempty units across a locality. Then one can fit the Poisson Distribution to the distribution for site frequency by spatial unit as modified above to determine if that distribution matches what would be observed if it were generated through a random placement of sites in the locality. Details of this procedure will be given in a separate report which examines the spatial distribution of sites at the local, rather than the global level of this report. That report will also incorporate autocorrelation analysis as a means to overcome the insensitivity of the Poisson test to units with like number of sites being contiguous.

The other problem, lack of consistent procedures throughout the region, is reconciled through examining patterns at a scale greater than the scale of the research projects from which the data were generated. Thus regionwide pattern is searched for at a scale of tens of kilometers, whereas much of the research work is likely to be at a scale of ones of kilometers with respect to intensive search for sites. For the purposes of this report, the region is divided into spatial units of approximate size 3 x 5 kilometers. All sites found in such a spatial unit are treated as if they are from the same point. Analysis of pattern can then be at two levels: spatial units measured on a two point scale--0 if there are no sites in that unit and 1 if there is at least one site--and spatial units measured according to the actual frequency of sites in the unit for the 2,000 sites of the data set. The former discounts are inequality from one unit to another that may be due to unequal intensity of survey in the locality around which a site was found, while the latter allows some of the complexity at the local level to be preserved.

If one allows that this prior research has been reasonably consistent at establishing localities where there are sites throughout the region, and that the previous work has not been particularly biased in terms of localities to be examined when viewed at a regional scale, then the locality of sites, at a scale of 5 - 10 kilometers, may plausibly be a reasonable sample of the actual distribution of site localities.

The sites are stratified according to the type scheme developed for the project--multiple use, limited use, isolated find and special site-and the spatial distribution of each type is analyzed. Then sites as distributed by type and other attributes (e.g., site subtype, site area, etc.) are analyzed for spatial patterning. This procedure is continued until further analysis is uniformative at a global level (see Read, 1979, for a discussion of this type of research approach).

What will be presented in this report are generalizations about the global pattern of site distribution that can be made with these data.

Spatial Distribution of Site Types

The spatial distribution of site types is distinct for each type, suggesting that the typology of site types is sensitive to a significant dimension that relates to site location. The following observations characterize this overall distribution.

(A) Multiple Use Sites

Distinct spatially defined clusters are found in a plot of site locations, with a size gradient for the diameter of the clusters running from west to east. In the west there appears to be one or two site clusters with diameter approximately 150 km and distance between sites around 15 - 20 km. (Note: The distance between sites is only meaningful in a relative sense as much of the void area between sites is simply area that has not been surveyed for site location.) Towards the east, the clusters are on the order of 50 km in diameter with distance between sites around 5 - 10 km. The clusters exhibited by the Multiple Activity (MA) sites are well separated. There is upwards to 50 km of blank area between clusters.

This distance between clusters, as well as the fact that there are other types of sites in some of these blank areas, suggests that this general patterning of MA site clusters is not an artifice of uneven data recovery for MA sites. Further, the definition of MA sites has been made separately from the original research projects, so that any bias towards collecting particular types of sites in the original research is not likely to be matched precisely by the typology of sites being used here. Thus, this pattern of site clusters suggests that the whole region can be divided into subregions of relatively high intensity of use and boundary regions with low intensity of use. The east-west gradient suggests two explanations: (1) a change in aspects of social organization reflected in site spatial distribution and/or (2) a difference in resource density and dispersion with more localized areas of resources in the eastern part of the region than in the western portion.

The rather clear separation of the western subregion from the eastern subregion suggests that this may be a societal boundary as well. As mentioned above, there are a few isolated and limited activity sites in part (but not all) of the boundary area, indicating that the absence of MA sites is not simply explainable as a consequence of erratic sampling. Part of the boundary (the northern part of the western subregion) is also characterized by complete absence of sites of any kind. Assuming this is not the consequence of lack of previous research in this area, it follows that there are major differences in the use of space by the prehistoric inhabitants of the project region.

The MA sites are also characterized by lack of local clustering within the large scale clusters. While occasionally two sites may be close together, the pattern is generally what would be expected under random distribution of sites in subregions. Thus the western group of sites, spread over an area of approximate diameter 150 km, can be seen as sites "randomly" distributed throughout that subregion without any marked clustering of MA sites in that area. There is some suggestion of differential density over this western subregion, with a greater density towards the southern part than towards the northern part.

The spatial goruping of these sites by site clusters do not correspond to any simple division of the region by valleys. Instead, the clusters, in many cases, crosscut valleys. This may only reflect both the fact that no valley was, by itself, sufficiently large to encompass the settlement system of a single society, and valleys are not isolated "islands" of resources.

Overall, the MA sites suggest that there are specific "centers" around which these sites tend to be distributed, with a low density of sites outside these "centers." The exception to this pattern is the western section which seems to be just one undifferentiated spatial distribution of sites.

The western section is given geographically by the area within the following ranges for the Northing and Easting co-ordinates: 440 Easting 600, and 4200 Northing 4380 (all Northing and Easting co-ordinates, both here and below, are in kilometers). The geographical location for the concentrations of sites are as given in the following table (Table 2.2.4.2-1).

The density figures in Table 2.2.4.2-1 represent relative density of clusters since only a small, but unknown fraction of the area for each cluster has been systematically investigated. Nonetheless, the figures suggest a rather striking homogeneity in the density of these site groupings, with 2 notable exceptions, Groups 1 and 14. Group 1 is separated from all other MA sites by about 20 km and Group 14 is separated by perhaps 25 km (again noting that these seemingly void areas may only be due to lack of intensive work in these areas).

(B) Limited Activity Sites

Differences between Limited Activity (LA) site and MA site spatial distributions are partly a result of substantially different sample sizes (there are about three times as many LA sites as there are MA sites), so that more of the local properties of site distributions may be observed for the LA sites. For the LA sites, the most striking pattern is separation of the easternmost sites from the other sites. A line running southeast starting at (E 705, N 4450) running to (E 810, N 4250) and then due east is the dividing line between the two spatial distributions. The division

Table 2.2.4.2-1. Geographical location of clusters of multiple activity sites.

CLUSTER NO.	EASTING[2]	NORTHING	APPROX. DIAMETER	NO. OF SITES	DENSITY
1	560	4,120	10	10	0.13
2	630	4,260	25	9	0.02
3	640	4,360	20	7	0.02
4	640	4,220	10	3	0.04
5	670	4,150	45[1]	29	0.02
6	710	4,235	15	8	0.02
7	700	4,285	25	8	0.05
8	715	4,340	15	8	0.02
9	740	4,175	55	20	0.01
10	755	4,250	30	11	0.02
11	760	4,320	15	7	0.04
12	780	4,110	25	14	0.03
13	790	4,400	40[1]	24	0.02
14	810	4,360	15	20	0.10
15	850	4,275	20	10	0.03
16	880	4,375	20	9	0.03
17	920	4,385	30[1]	7	0.01
18	910	4,500	30	7	0.01

4060

[1]Cluster is oval shaped. The diameter is the major axis. The density is computed, assuming the cluster is circular.

[2]Easting figures for UTM 12 are modified by the formula, New Easting = Old Easting + 520.

is about 50 km wide, with only about four LA sites in this band going SE as described above. It is interesting to note that there are about 12 MA sites in that band, including Group 11 from Table 2.2.4.2-1. Thus with about one-third as many sites overall, the MA sites have three times the representation in this band separating the two sets of LA sites, yielding a 9:1 differential between the MA sites and LA sites. This differential supports the previous argument that the typology of sites seems to be tapping a significant dimension for spacial distribution of sites. The lack of LA sites in the band is thus not likely to be due to sampling error. And immediately outside of the 50 km wide band the LA sites are at a high density.

The separation found in the western part of the region for MA sites is also reflected in the LA sites, but not as strongly, and without the marked division found for the LA sites in the eastern part of the region.

The LA sites seem to be spatially distributed at two levels: (1) a random distribution of sites with relatively low density over fairly large areas and (2) concentrations of LA sites with high density in these concentrations. The latter do not correspond in any simple manner with the MA site groups. In some cases the closest LA and MA site groups are separated from one another. In other cases there is complete overlap, and in yet other cases the groups are adjacent to one another. Table 2.2.4.2-2 gives the locations, size, number of sites and density for the dense groupings of LA sites.

The previous comment about the meaning of the density figures applies in a similar fashion to the LA sites. Nonetheless, a more varied pattern can be seen, as well as density figures generally more than three times as great as for the MA sites, indicating that the LA sites are more "clustered" than the MA sites. There are some striking differences between the LA site groups and the MA site groups. Group 7 for the LA sites, which contains the greatest number of sites, is in an area with a <u>low</u> density of MA sites. The corresponding MA site group is Group 3 with seven sites and a density of 0.02. There are 15 times as many LA sites as there are MA sites, or, when corrected for the greater number of LA sites overall, five times as many LA sites as would be expected given the number of MA sites. On the other hand, Group 6 for the LA sites has 19 sites, whereas the corresponding group of MA sites, Group 6, has 29 sites, showing a substantial <u>under</u>representation of LA sites in that locality. These two sets of groups represent the northern and the southern parts of the central subregion. There appears to be, then, a gradient in the central portion of the region with a higher proportion of LA sites (both relatively and absolutely) in comparison to MA sites, changing to a reverse proportion of LA sites (both relatively and absolutely) in comparison to MA sites in the southern portion of the central subregion. This gradient runs at approximately a 45 degree angle going SE from (E 630, N 4440).

Another notable discrepancy between the two distributions is LA site Group 4 which is in a locality devoid of MA sites.

Overall, these two spatial distributions show some rather striking differences in the spatial distribution of LA sites and MA sites. The most obvious explanation for these differences is differential rough distribution of vegetal resources which are, presumably, determining whether there are MA Or LA sites in that locality. This, however, is a topic outside of the scope of this report.

Table 2.2.4.2-2. Location of clusters of limited activity sites.

CLUSTER NO.	EASTING[2]	NORTHING	APPROX. DIAMETER	NO. OF SITES	DENSITY
1	460	4,225	25	38	0.12
2	480	4,335	15	34	0.19
3	570	4,285	30[1]	33	0.05
4	530	4,410	20	11	0.04
5	630	4,275	25[1]	46	0.09
6	665	4,160	20	19	0.06
7	640	4,375	40	125	0.10
8	665	4,325	10	13	0.17
9	700	4,300	25	44	0.09
10	755	4,175	30	44	0.06
11	785	4,415	15	14	0.08
12	815	4,360	20	55	0.18
13	825	4,415	15	8	0.05
14	870	4,275	35	71	0.07
15	930	4,390	40[1]	22	0.02

4061

[1]Oval shaped. The diameter is the major axis. The density is computed assuming it is a circle.

[2]For UTM 12, Easting is modified by the formula, New Easting = Old Easting + 520.

(C) Isolated Sites

These sites seem to be characterized by a more or less random distribution (with changing density) over the region. There is an absence of Isolated sites in the northern part of the western subregion which matches the similar absence of LA and MA sites in that locality. The distribution of these sites follows what would be expected under a model for these sites as representing short term, single season camps which exploit resources that are only available locally on an occasional basis.

Description of Site Types by Site Area

Using the notion that site area reflects amount of use of a location (either on a short-term, long-term, or repeated basis), site areas will give an indication of subregions that were used for longer or shorter periods of time and by more or fewer numbers of people. Site area should thus be representing both societal and environmental factors in the location and number of persons in settlements. As noted earlier, the smallest MA and LA sites are likely to represent single camps over perhaps a few years of repeated use of the same locality, whereas the largest sites are likely the result of several camps using the same location over tens, if not hundreds, of years.

A crude site area scale has been used here. Cutpoints of 1,000, 10,000, 100,000, and 1,000,000 square meters have been chosen on the basis of the previous argument about the buildup of sites through repeated use of the same locality in different years. Data on San camps in the northwestern portion of the Kalahari Desert suggest that an area on the order of 500 square meters is a large camp. Thus the 1,000 and 10,000 M^2 cutpoints should incorporate all localities with only short-term camps. Similarly, the 100,000 and 1,000,000 M^2 cutpoints should restrict the sites to those the sites to those produced through unusually large aggregations of persons. Hence, while the scale is crude, it should suffice for segregating major differences in the development of sites.

Site areas are considered first with regard to the stratification into types of sites given above, with the exception that only MA and LA sites are examined. By definition, Isolated sites are of minimal area and Special Activity sites are a catch all category with no particular basis for expecting any common site formation process.

Consider the MA sites. The total region is first divided into 3 subregions: the western portion defined by the break in MA site distribution as noted earlier, and the middle portion and the eastern portions, with the latter determined by the break in the LA site distribution, as described above. Table 2.2.4.2-3 gives the frequency of site sizes in each of these areas for the MA sites.

In Table 2.2.4.2-4 are given the number of spatial units of size 3 x 5 km which contain at least one site.

Three distinct patterns emerge. In subregion I, there is a clear trend towards an increasing frequency of larger sites. This suggests a pattern in which a relatively few localities are repeatedly utilized, which would occur if there are, for example, a few, significant environmentally determined constraints onsite location such as location of water during the dry season, and which are spatially constant through time.

Table 2.2.4.2-3. Site areas for multiple activity sites in three subregions.

SUBREGION	A	B	C	D	E	TOTAL NO. OF SITES
Western (I)	11	7	13	0	2	31
Central (II)	54	29	17	11	1	112
Eastern (III)	20	19	11	5	1	56

4062

A - Sites with area < 1,000 M^2

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area < 1,000,000 M^2

Table 2.2.4.2-4. Distribution of site area for multiple activity sites by spatial unit.

SUBREGION	A	B	C	D	E	NUMBER OF SPATIAL UNITS
Western (I)	4	7	11	0	2	24
Central (II)	46	24	14	8	1	93
Eastern (III)	14	14	9	5	1	43

4063

A - Sites with area < 1,000 M^2

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area > 1,000,000 M^2

Subregion II has a pattern that would be expected on the basis of likelihood of shorter versus longer term of occupation without significant environmental constraint, and is similar to what one sees in other contexts for size of settlement and frequency of occurrence. The pattern is similar to what occurs when constraints are primarily those of spatial distance and/or internal dynamics of the settlement system, rather than extrinsic to the system (as seems to be the case for the western subregion) and formed to the system (as seems to be the case for the western subregion) and formed by the sheer need for food resources and the spatial location and density of those resources. In fact, the plot of subregion II from Table 2.2.4.2-4 provides a classical example of Zipf's rank-size rule. This is rather extraordinary in as much as the dynamics of settlement systems which follow Zipf's rule are usually market economies. The suggestion is quite strong that the Central portion of the regions is based on a radically different set of constraints (or lack of constraints) than is the case for the Western portion of the region. No suggestion is being made here of a market economy in this region, only that in the Central subregion it is internal dynamics which seem to have the greatest influence onsite area frequencies.

Curiously, the eastern portion seems to be halfway between the western and the central portions. Here, there is approximately a uniform disgribution of site size, suggesting a balance between the possibly external constraints of the Western subregion and the possibly internal constraints of the Central subregion.

The largest sites--category E--follow a pattern that separates them from the other sites. The western section has the fewest sites but proportionally the greatest number of extremely large sites. Further, this abondance is reinforced by the absence of sites in the range 100,000 to 1,000,000 M^2. The one large site in the central section seems to be but the extremal value in a distribution of sites and may be nothing more than that. Finally, the eastern section seems to have a relatively constant number of sites except for the largest category, suggesting that cutpoint of 1,000 M^2 might be arbitrary for sites in this subregion, which would occur if camps are consistently much larger in the eastern subregion.

The LA sites can be examined in a similar fashion and the pattern is quite different from the MA site pattern in subregions II and III. Table 2.2.4.2-5 gives the data for the number of LA sites of each size class for the 3 subregions.

Table 2.2.4.2-6 gives the distribution of site area for spatial units as defined for Table 2.2.4.2-4.

Here, all site size distributions (in both Tables 2.2.4.2-5 and 2.2.4.2-6) for subregions II and III of the LA sites are alike that of subregion II for MA sites, and the distribution of subregion I is like that of subregions III for the MA sites. That is, in all cases there is a consistent shift from MA to LA sites towards the subregion II distribution for MA sites. If the MA subregion II sites are compared with those from subregions II and III of LA sites, there is essentially no difference in relative number of spatial units in which sites are found, and an insignificant difference in the relative number of sites which are found in the several subregions for the five area classes. These results are shown in the chi-square tests given in Table 2.2.4.2-7.

Table 2.2.4.2-5. Distribution of site areas for limited activity sites.

SUBREGION	A	B	C	D	E	NUMBER OF SITES
Western (I)	54	53	23	5	1	126
Central (II)	204	87	59	17	0	367
Eastern (III)	63	29	9	4	1	106

4064

A - Sites with area < 1,000 M^2

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area > 1,000,000 M^2

Table 2.2.4.2-6. Distribution of site areas for limited activity sites by spatial unit.

SUBREGION	A	B	C	D	E	NUMBER OF SPATIAL UNITS
Western (I)	35	35	17	4	1	91
Central (II)	124	66	41	17	0	248
Eastern (III)	38	25	8	4	1	76

4065

A - Sites with area $< 1,000\ M^2$

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area $> 1,000,000\ M^2$

Table 2.2.4.2-7. Chi-square test for homogeneity of site area distributions.

SITE TYPE	NUMBER OF SITES FOR EACH SITE AREA CLASS					
	A	B	C	D	E	TOTAL
Observed						
MA Sites (II)	54	29	17	11	1	112
LA Sites (II)	204	87	59	17	0	367
LA Sites (III)	63	29	9	4	1	106
Expected						
MA Sites (II)	61	28	16	6	0.4	
LA Sites (II)	201	91	53	20	1.2	
LA Sites (III)	58	26	15	6	0.4	

4066

X^2 = 13.3, 8 degrees of freedom, $p > 0.05$.

A = Sites with area < 1,000 M^2.

B = Sites with area between 1,000 and 10,000 M^2.

C = Sites with area between 10,000 and 100,000 M^2.

D = Sites with area between 100,000 and 1,000,000 M^2.

E = Sites with area > 1,000,000 M^2.

Both of these tests indicate that these three subregions do not differ with regard to the patterning of frequency by site area classification. For the spatial units, the observed and expected values are almost identical in the Chi-square test. Given the fact that these data have been collected by a myriad of investigators over several decades, the identicalness of the relative frequency distributions over these subregions is rather remarkable. These subregions only differ, then, in the absolute numbers of sites and site locations.

Subregion III of the MA sites and subregion I of the LA sites also have similar distributions of site frequencies. Table 2.2.4.2-9 gives a Chi-square test for homogeneity for the spatial units for these two subregions.

Again, the agreement between the two sets of sites is striking. A possible explanation for the similarity is that the 1,000 M^2 cutpoint is incorrect and the distribution of site areas is approximately uniform over 0 to 10,000 M^2. If the first two site area classes are combined, then the resulting distribution pattern matches that for the equivalent classes in the Chi-square tests given in Tables 2.2.4.2-7 and 2.2.4.2-8. As noted earlier, this interpretation also suggests that camp sizes, and/or repeated use of the same locality, are consistently greater in the eastern subregion than in the central subregion.

Next, consider the spatial distribution of sites stratified by site area. For the MA sites, no clearcut difference in spatial distribution of sites by site area appears with the exception of the center of the central subregion wherein there is a spatially clustered concentration of large sites (defined here as sites with area greater than 100,000 M^2). In the area bounded approximately by E 680 to E 735 and by N 4225 to N 4310a there are six sites of area - 100,000. These six sites are about one third of the large sites in the whole region whereas the area of this locality is about 4645 sq km, or only about 1/25 of the total area, suggesting a density of large sites in this locality some eight times as great as on the average. These six sites are to be found in Groups 4, 5 and 8. A fourth Group, No. 13, also has three large sites, but is at some distance from these three groups of MA sites. (The third Group, No. 8, only has one large site, but is physically close to Groups 4 and 5 and so was included in the above argument.)

The remaining large MA sites are dispersed across the entire region. The western subregion has 2 of the largest sites, while the other 2 largest sites are in the eastern subregion. Table 2.2.4.2-10 gives the number of large sites and the number of other sites by subregion.

This table shows that the relative frequency of large sites is constant in the three subregions, even though the pattern of small to large sites is not the same. The simplest explanation is that both the total number of sites and the number of large sites is proportional to population density, with the internal structuring of these sets of sites, both spatially and in terms of relative frequency of large and small sites, affected by the settlement system of each subregion. The more or less random distribution of large sites (excepting the clustered large sites discussed above) is consistent with a hypothesis of these representing localities where there may be unusually large aggregations of persons due more to internal dynamics of social organization than just resource distribution, while the clustering of large sites in the center of the central subregion may be reflecting an area of greater resource availability, so that in conjunction with a presumed greater population density for

Table 2.2.4.2-8. Chi-square test for homogeneity of site area for spatial units.

OBSERVED FREQUENCY DISTRIBUTION FOR SPATIAL UNITS						
SITE TYPE	A	B	C	D	E	TOTAL
MA Sites (II)	46	24	14	8	1	93
LA Sites (II)	124	66	41	17	0	248
LA Sites (III)	38	25	8	4	1	76
EXPECTED FREQUENCY DISTRIBUTION FOR SPATIAL UNITS						
MA Sites (II)	46	25	14	6	0.7	
LA Sites (II)	123	68	37	17	1.8	
LA Sites (III)	39	21	12	5	0.6	

4067

$X^2 = 3.5$, 8 degrees of freedom, $p > 0.50$

A - Sites with area < 1,000 M^2

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area > 1,000,000 M^2

Table 2.2.4.2-9. Chi-square test for homogeneity of site frequencies for spatial units.

OBSERVED SITE FREQUENCIES						
SITE TYPE	A	B	C	D	E	TOTAL
MA Sites (II)	14	14	9	5	–	42
LA Sites (I)	35	34	17	5	–	91
EXPECTED FREQUENCIES						
MA Sites (II)	15	15	8	3		
LA Sites (I)	34	33	17	7		

4068

$X^2 = 2.2$, 3 degrees of freedom, $p > 0.20$

A - Sites with area < 1,000 M

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 100,000 and 1,000,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with Area > 1,000,000 M^2

the central subregion, this locality may be suitable for several large aggregations of persons and thus appears more patterned, in the sense of being clustered together, in their spatial distribution than is true for the other large sites.

The large LA sites differ in several ways in both frequency and spatial distribution from the MA large sites. First, there are relatively few large LA sites. There is but one site in excess of 1,000,000 M^2 and a total of 13 sites in excess of 100,000 M^2, versus 17 such MA sites despite there being about one third as many MA sites overall. The spatial distribution of most of the large LA sites matches that of the MA large sites: about one half of the large LA sites are within a few kilometers of a large MA site. The distribution of the large and small LA sites is given in Table 2.2.4.2-11.

Clearly, subregion II is over represented in comparison to subregions I and II. But in comparison to Table 2.2.4.2-10, subregion II has a proportion of large sites similar to that for the MA sites, and subregions I and III are substantially underrepresented. In other words, the western and eastern subregions would seem to be areas less amenable to large sites. But these two subregions also contain three of the four largest sites. This suggests that these largest sites are a result of processes other than simple utilization of resources. A possibility, as argued earlier, is that the larger MA sites represent areas where several camps may aggregate for part of the year for reasons relating more to the internal dynamics of the social systems represented by these sites than to resource density.

Stratification by Topographic Zone

Since the total area of each topographic zone is not presently available, the main comparison will be between LA and MA site areas for each topographic zone. The basic data are given in Table 2.2.4.2-12.

The distributions are essentially the same. Thus the main distinguishing feature is the number of units by topographic zone (though these relative frequencies need to be corrected by the area represented by each topographic zone). The pattern that has been observed in the Mojave (Coombs 1979) is repeated here. Namely, the zone between the Valley Bottom and the beginning of the Mountains has the fewest number of sites.

Mean site areas can also be compared. These are given in Table 2.2.4.2-13.

While the difference between the LA and the MA sites from the Playa zone may be due tc sampling error, the same is not true for the other zones. The pattern of site areas is a curious one with reversals between the LA and the MA sites. For the MA sites the rank order of the zones is given by 4, 2, 1, 5, 3. But for the LA sites the rank order is 3, 5, 2,4,1 which is almost the exact reverse of the sequence for the MA sites (only zone 1 is out of reverse order). This suggests an inverse relationship between the LA and the MA sites in which zones with large MA sites are zones with small LA sites, and conversely.

Zones 2 and 4 (Upper Bajada and Valley Bottom) stand out as locations for large MA sites. The four largest MA sites are in these two zones (three of them are in Zone 2 and one is in Zone 4). Since these zones contain all of the largest sites, it is also useful to compare the medians for these five zones. The medians are given in Table 2.2.4.2-14.

Table 2.2.4.2-10. Frequency distribution for large sites by subregion.

OBSERVED FREQUENCY DISTRIBUTION		
SUBREGION	AREA GREATER THAN 100,000 M^2	AREA LESS THAN 100,000 M^2
I	2	22
II	9	84
III	6	37
EXPECTED FREQUENCY DISTRIBUTION		
I	2.6	21.4
II	9.9	83.1
III	4.6	38.4

4069

$X^2 = 0.72$, 2 degrees of freedom, $p > 0.80$

Table 2.2.4.2-11. Frequency distribution of site size by subregion for limited activity sites.

SUBREGION	AREA GREATER THAN 100,00 M^2	AREA LESS THAN 100,000 M^2
I	4	86
II	21	231
III	4	71

4070

Table 2.2.4.2-12. Frequency distribution of spatial units by topographic zone.

TOPOGRAPHIC ZONE	OBSERVED FREQUENCIES		EXPECTED FREQUENCIES	
	LA UNITS	MA UNITS	LA UNITS	MA UNITS
Mountain (1)	225	78	224	79
Upper Bajada (2)	154	69	165	58
Lower Bajada (3)	114	27	104	37
Valley Bottom (4)	131	44	130	45
Playa (5)	6	3	7	2
Total	630	221		

$\chi^2 = 7.2$, $df = 4$, $p > 0.10$

4071

Table 2.2.4.2-13. Mean site areas for topographic zones (in square meters).[1]

TOPOGRAPHIC ZONE	LA SITES	MA SITES
Mountain	15,000	26,400
Upper Bajada	26,400	70,000
Lower Bajada	34,500	10,500
Valley Bottom	25,900	142,300
Playa	27,200	12,900

4072

[1]Standard deviations are approximately 1/3 to 1/2 of the mean site area. Since the distributions are highly skewed by large sites, the standard deviations are not given.

Table 2.2.4.2-14. Median site areas for topographic zones.

TOPOGRAPHIC ZONE	MEDIAN LA SITE AREA	MEDIAN MA SITE AREA
Mountain	930	1,443
Upper Bajada	1,480	4,047
Lower Bajada	471	502
Valley Bottom	400	6,283
Playa	104	88

4073

The medians give about the same ranks for the topographic zones for MA sites. However, the ranking for these zones for the LA sites differs considerably from that based onsite area. Because of the biasing effect of a few large sites on the mean area, the medians may be a better indication of the pattern of site size by topographic zone. Zones 2 and 4 still remain the zones with the largest MA sites, and the pattern of zone 4 of having the largest mean site area for MA sites and the smallest mean site area for LA sites is almost perfectly duplicated for these median values. Only the Playa zone has a smaller median for LA sites than does the Valley Bottom Zone.

The breakdown of site area by topographic zone also allows evaluation of the cutpoints used in the analysis of site area. The next table (Table 2.2.4.2-15) gives the natural breaks in the frequency distribution of site area by topographic zone.

These cutpoints are quite close to the values actually used; the main "error" is in the upper limits. These data suggest refined cutpoints of 0 - 1,000; 1,000 -10,000; 10,000 - 50,000; 50,000 - 250,000; 250,000+. However, these new divisions do not change the results of the analysis given above. It is rather remarkable that the cutpoints argued on theoretical grounds should also be matched so clearly in the empirical data both in terms of numbers of intervals and limits for these intervals. It appears that site area can be meaningfully discussed in terms of five site area ranges which are interpretable in terms of processes of site formation.

Of the five topographic zones, the area least likely for the largest aggregations would likely be the mountain area. This may be tested through the site distribution for large and small sites in the topographic zones. The basic data are given in Table 2.2.4.2-16.

It may be seen by inspection that Valley Bottom has about twice the proportion of large sites as does Mountain and Upper Bajada. Interestingly, the Lower Bajada is both the area with the fewest number of sites and a virtual absence of large sites. Of the largest sites, the biggest Mountain site is about 400,000 m^2, whereas the Upper Bajada has one site over a million square meters and the Valley Bottom has two such sites. For the Lower Bajada sites, sites with area 10,000 m^2 represent 85 percent of the sites; comparable figures for the Mountain, Upper Bajada and Valley Bottom are: 74 percent, 65 percent and 54 percent, respectively. Thus, there is a rather consistent pattern of avoidance for the Lower Bajada and a gradient in the other three zones running from Mountain to Upper Bajada to Valley Bottom in terms of increasing percentage of larger sites. These figures also support the interpretation of the largest sites as representing aggregations due to social dynamics, as opposed to simple resource distribution.

The LA sites show a slightly different pattern. The separation into size categories is not as pronounced, though there are striking differences in the frequency distributions for site areas in the five zones. This can be seen in a table for percentage rank of the cutpoints of site size (Table 2.2.4.2-17).

For zones 3 and 4 (Lower Bajada and Valley Bottom) there are both more small sites and more large sites. This suggests that at higher elevations a given resource locality is exploited over longer periods of time, but that long-term exploitation of a single resource locality occurs primarily in the Valley Bottom.

Table 2.2.4.2-15. Cutpoints in the frequency distribution of the MA site area by topographic zone.

MOUNTAIN CUTPOINTS				
0-1120	1767-8094	10000-19684	30000-202000	250000-404000
UPPER BAJADA CUTPOINTS				
0-982	1640-8094	11163-41861	60476-221027	508000-1593000
LOWER BAJADA CUTPOINTS				
0-875	1895-8767	22326-39270	162086	
VALLEY BOTTOM CUTPOINTS				
0-500	1096-7854	10000-54978	117810-176315	508327-2000000
PLAYA CUTPOINTS				
0-88		38543		

4074

The numbers are the largest and smallest site areas for each of the intervals.

Table 2.2.4.2-16. Frequency distribution for small, medium, and large sites in five topographic zones.

TOPOGRAPHIC ZONE	SMALL SITES	MEDIUM SITES	LARGE SITES	PERCENT MEDIUM AND LARGE SITES
Mountain	69	7	2	12
Upper Bajada	59	8	2	14
Lower Bajada	26	1	0	4
Valley Bottom	34	6	4	25
Playa	3	0	0	0

4075

Small: 0 to 100,000 M^2
Medium: 100,000 to 1,000,000 M^2
Large: >1,000,000 M^2

Table 2.2.4.2-17. Percentage of limited activity sites by topographic zone.

TOPOGRAPHIC ZONE	A	B	C	D	E
Mountain	50%	80%	96%	100%	100%
Upper Bajada	44%	77%	96%	100%	100%
Lower Bajada	65%	85%	94%	99%	100%
Valley Bottom	61%	85%	95%	99%	100%
Playa	66%	83%	100%	100%	100%

4076

A - Sites with area < 1,000 M^2

B - Sites with area between 1,000 and 10,000 M^2

C - Sites with area between 10,000 and 100,000 M^2

D - Sites with area between 100,000 and 1,000,000 M^2

E - Sites with area > 1,000,000 M^2

Landform

The site distribution for MA site area across landform is largely homogeneous with the exception of Dines, Flat/Valley Plain and Gentle Slope/Alluvial Fan. These landforms are the locus for the largest sites. These three groups contain the four largest sites even though only about 1/3 of the sites are to be found on these landforms.

The distribution of LA sites across landforms is much like that of the MA sites, except that there are no large LA sites in the Dune area (the largest LA site in that landform is about 8,000 m^2.

Taken together, these distributions for LA and MA sites across landforms suggest that the presence of large MA sites excludes the presence of large LA sites. In other words, the "role" of the Limited Activity sites is being subsumed by the Multiple Activity sites.

Conclusion

The analysis of the spatial distribution of these sites has established several points: (1) the usefulness of examining spatial distributions at a large scale, global level, (2) the existence of several radically different patterns of the use of space in the project region, (3) the success of the site typology in dividing the sites into categories which have different spatial distributions, (4) the existence of subareas which appear to be "boundary" areas between subregional spatial distribution of sites, (5) the general lack of correspondence between hydrologically defined valleys and the spatial location of site clusters identified at a global level, (6) the presence of a naturally definable categorization of site areas into five classes of site area, (7) different distribution of site area by topographic zone and (8), general correspondence between empirical observations onsite area frequencies and theoretical predictions based on a general model of site formation.

The analysis has been guided by a model of site formation as a process of repeated use of the same locality. A model is given for both settlement population size based on ethnographic study of foraging societies and for settlement living area. These models are used to establish the general characteristics of the total set of sites that have been generated in this region through some 3,500 years of settlement location during the yearly round of subsistence activities. The predictions of the model and the empirical data are found to be in close agreement.

These results suggest that this model should be developed further as a means to provide an overall research framework for the study of the cultural resources. It is suggested that this research framework should be primarily oriented towards a study of regional rather than local properties of the prehistory of the area. The present report is obviously inadequate from the perspective of the intensive study of a locality, but provides an overarching framework within which such studies may be integrated. The need for such integration is partially indicated by the degree to which research in this area has tended to take properties of the sites in a limited locality as global properties without simultaneously demonstrating that such generalization is valid.

This report has barely begun the study of global properties of site distribution and its interpretation for the Great Basin. As noted above, one of the most serious defects in the present set is the lack of an adequate set of measures over sites. The present site typology has succeeded in uncovering rather significant patterns of site distribution, but obviously needs refinement. Refinement will require both theoretical considerations and the pragmatic problem of what can be measured quickly and reliably in the field. The general direction for a refined site typology is most likely that of an adequate classification of artifactual material and the measure of the frequency distribution for such a classification on each site. But this will require reexamining present typologies to determine if it is possible, as is most likely the case, to provide classes which are more directly measuring specific activities that took place at the settlements for which the sites are a representation. Read (1980) has shown how such a refinement may be done for projectile points, and Decker (1978) has established the possibility of objectively formulating a typology of utilized flakes that is directly measuring the mechanics of the use of utilized flakes.

The present analysis also suggests several specific tasks that need to be undertaken. First, the results of this analysis need to be verified with the data from Stage I sampling. The present data set has been collected with unknown relationship to either the population of sites in this region or to their spatial distribution. The Stage I data should be able, for example, to either corroborate or revise conclusions made in this report regarding boundaries for site distribution at a global level. Second, the two sets of data need to be integrated and a refined analysis made, including an analysis of site distribution at a more local level. Third, the data presently being measured on sites needs to be evaluated in terms of the requirements of spatial analysis oriented towards establishing the processes that led to settlement location. Fourth, data on resource distribution in the region needs to be integrated into the research. Fifth, the outlines for further stages of sampling need to be formulated. The results of the present analysis suggest a number of directions that future sampling can profitably be oriented towards. These range from providing more intensive coverage of the whole region, to more intensive coverage of specified localities in the whole region, to intensive study of a limited portion of the region.

Finally, consideration needs to be made of what constitutes adequate mitigation in a project of this magitude. The result of the analyses in this report argue strongly against any notion of mitigation being defined on an individual site basis. It is complexes of sites and their spatial distribution that provide irreplaceable scientific information. While an Isolate can, at one level, be seen as unimportant, a total collection of Isolates has a value that is not the sum of each Isolate. The collection also contains information on the spatial location of a certain class of settlements (assuming the argument presented in this report regarding the interpretation of the Isolate as a small settlement is accepted) and it is that set of information which is an inseparable part of understanding the archaeological record. Thus, mitigation needs to be defined not just in terms of preservation or recording of information from sites seen as isolated entities, but must include preservation and recording of information on the system for which these sites are a representation.

Analysis of Cultural Resource Data from an Intensive Sample Survey on Nellis Air Force Range (2.2.4.3)

In 1978, the Archaeological Research Center of the University of Nevada, Las Vegas, conducted a cultural resources inventory of the Nellis Air Force Range. The data from this survey provide an opportunity to assess a number of aspects of cultural resource density and distribution that could not be considered with the existing data base for the entire M-X study region. For example, the regional data base considers topographic zone and landform, but contains no information on vegetation type. Because vegetation was one of the criteria incorporated in the stratification scheme employed on Nellis Air Force Range these data provide an opportunity for refining inferences regarding cultural resource distribution in relation to vegetation types. In addition, it is a well-established fact that within the Great Basin sites tend to occur in association with springs, but the Nellis data allow a more detailed exploration of the spatial patterning of archaeological resources that occurs with increasing distance from springs. Finally, these data provide a means for assessing differences in site density that occur in different environmental settings within a large region such as was sampled on Nellis.

One of the simplest steps in this latter direction involves an examination of the basic statistics which describe the results of the regional sample. Tables 2.2.4.3-1 and 2.2.4.3-2, for example, contain a number of comparative statistics for the various sampling strata. (Note the original "spring" stratum has been divided, for purposes of analysis, into "spring" and "well" categories. These data are from the 1 percent sample of the North Range only.) Any of these may serve as potential estimates of site density or distribution. Measures B and C are particularly valuable, since they are mathematically independent estimators.

It is noteworthy that all three statistics suggest the predominance of prehistoric sites (Table 2.2.4.3-1) in two sampling domains: the Spring and Pinyon/Juniper strata. This is consistent with other results from the Great Basin and should be taken as evidence that prehistoric cultural resources are especially common in these environments.

It should also be pointed out that the three measures depicted in Table 2.2.4.3-1 are also quite consistent in terms of their predictions with respect to prehistoric sites. That is, the ordering of sampling domains based on each statistic is quite similar. For example, the rank-order correlation measure, Spearman's r, attains a value of + 0.49 when the rankings based on the two independent measures are compared. This consistency suggests two conditions. First, it provides supportive evidence that each of these estimators of site patterning has some validity. Secondly, it suggests that prehistoric sites in the study area tend to be distributed in a particular fashion: specifically, sites tend to be comparatively dense (Measure C) in those environmental domains in which one is most likely to find sites (Measure B).

One of the factors that must be considered in evaluating Table 2.2.4.3-1 is the number of sample units inventoried for each particular stratum. In general, the more observations that contribute to a given measure, the more reliable that measure will be. This is reflected in the ranges provided for Measure B. More precisely, these range predictions are 90 percent confidence limits based on the binomial distribution. Note, for example, that the range limitations for three strata (Wells, Playa, and Unclassified Mountains) fail to exclude any possibilities. This is because the sample sizes involved are so small. Accordingly, one should be particularly cautious when attempting to interpret the results from these strata.

Results from the Eureka Valley Planning Unit in California, for example, would suggest that prehistoric site densities in the Unclassified Mountain domain are actually comparatively high (on the order of six sites per square mile). Eureka Valley is used for comparison here because of its geographical proximity to Nellis

Table 2.2.4.3-1. The distribution of prehistoric sites by sampling stratum.

STRATIFICATION	A. SITES/ SQ MI	B. PERCENTAGE OF SAMPLE UNITS WITH SITES	C. SITES/SAMPLE UNIT WITH SITES
Spring	13.4	78 (58-96)	2.2
Well	0	0 (0-1)	-
Lake Terrace	3.0	24 (23-37)	1.5
Playa	4.0	58 (0-1)	1.0
Playa Margin	7.4	40 (22-45)	2.3
N. Desert Shrub	4.5	33 (21-45)	1.7
Salt Desert Shrub	5.6	33 (23-44)	2.1
Unclassified Mts	0	0 (0-1)	-
Pinyon/Juniper	13.0	62 (47-78)	2.6

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Table 2.2.4.3-2. The distribution of historic sites by sampling stratum.

STRATIFICATION	A. SITES/ SQ MI	B. PERCENTAGE OF SAMPLE UNITS WITH SITES	C. SITES/SAMPLE UNIT WITH SITES
Spring	8.5	78 (58-96)	1.4
Well	10.6	100 (0-1)	1.3
Lake Terrace	0.4	2 (0-8)	2.0
Playa	0	0 (0-100)	-
Playa Margin	2.2	16 (2-31)	1.8
N. Desert Shrub	1.2	10 (2-18)	1.5
Salt Desert Shrub	0.5	100 (0-100)	1.1
Unclassified Mts	0	100 (0-100)	1.0
Pinyon Juniper	0.5	6 (0-16)	0.9

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Table 2.2.4.3-3. Site clustering information.

STRATIFICATION CATEGORY	SAMPLE SIZE	CLUSTERING COEFFICIENT	LARGEST NO. OF OBSERVATIONS IN ANY SAMPLE UNIT	PROBABILITY
Spring	18	0.38	18	0.001
Well	3	1.0	3	0.11
Lake Terrace	41	0.35	4	0.04
Playa	2	Undefined	1	–
Playa Margin	25	0.33	8	0.01
No. Desert Shrub	52	0.30	6	0.09
Salt Desert Shrub	69	0.29	9	0.001
Unclassified Mts.	2	Undefined	0	1.0
Pinyon/Juniper	32	0.30	10	0.01

3982

and the striking similarity of site estimate parameters for the two regions. For example, 50 percent of the Eureka Valley sample units in the Pinyon/Juniper domain contain sites compared with 62 percent for Nellis, leading to density estimates of 12.0 and 13.0 sites per square mile, respectively. The BLM inventory of the Eureka Valley Planning Unit contained a third statrum: Valley Bottoms. Forty-three percent of the sample units in this domain contained prehistoric sites: 5.9 sites per square mile was estimated. Among other considerations, the similarities of the Nellis and Eureka Valley estimates support the notion that these figures have validity for other nearby areas within the Great Basin and may be used, with caution, as rough predictors for such areas.

Table 2.2.4.3-2 is identical to Table 2.2.4.3-1 except that historic rather than prehistoric sites are treated. Differences between strata are far less easy to characterize for historic sites, largely because the three measures of site density produce quite different rankings. The Lake Terrace domain, for example, ranked sixth among strata in terms of sites recorded per square mile, but first in terms of sites per sample unit with sites. Conversely, the Well domain ranked first and fifth, respectively. The Spearman's r-value for rankings based on Measures B and C is actually slightly negative, suggesting that there is considerable variability across strata in terms of within-stratum variation in the number of sites per sample unit. That is, some strata have few if any historic sites in most locations, but high site densities in a selechted number of highly localized areas, while other strata have low but relatively consistent numbers of sites in most areas. The Well and Lake Terrace strata reprectively, are perhaps the best examples of these two extremes. The discrepancies between these measurements may also lead one to question the overall reliability of any one measure as a predictor of historic site densities and distribution patterns within the study area.

It is perhaps important to note that the estimates of historic sites for the study area, on the one hand, and the Eureka Valley Planning Unit, on the other, are quite different. This is particularly true for Measure B; none of the three Eureka Valley strata yielded density estimates of one historic site/mi^2 or more. Obviously this weakens one's ability to successfully generalize from either of these sets of results to other areas.

There are a number of factors that should be considered whenever one attempts to estimate the absolute numbers of cultural resources within a region or area. One such factor is crew spacing, for obviously at least some cultural loci will not be observed unless that spacing is quite small. For both the Nellis and Eureka Valley inventories, crew spacing was fixed at a consistent 50 meters. This makes it relatively easy to compare the two sets of results, but it also suggests that many smaller sites and isolated artifacts were overlooked in both cases. Accordingly, it is important to state that the estimates provided above and in Tables 2.2.4.3-1 and 2.2.4.3-2 are more accurately described as predictions of what a new inventory, utilizing the same crew spacing and survey methods, would be expected to recover, rather than predictions of actual site numbers and densities. Clearly, the actual numbers of sites will be generally higher than the numbers provided here, but the magnitude of the difference is difficult to assess. Previous experience suggests that the numbers of isolated artifacts and small features is actually several times as large as any estimates based on 50-meter-spaced crew sweeps, that estimates for small flake scatter sites should be doubled at the very least, but that very few large or prominent sites are missed with this spacing.

Among the other factors that can adversely affect the integrity and meaningfulness of a set of site density estimates are: crew composition (i.e., the differential ability of crew members to recognize and record sites); weather conditions; the suitability of the terrain for observing sites; fatigue and other health factors; and so on. An effort was made to assess the possible influence of the first two of these on the site density estimates. This involved a fairly simple analytical design based on the principle of controlled comparison. The analysis failed to reveal any substantial variability resulting from either crew composition or weather conditions. (More analysis should be conducted before final conclusions regarding the effects of these agents are made.)

Certain other negative analytical results are worth detailing here as well. The first of these involves the construct/variable "hydrologic subunit." Eleven such subunits were identified and examined as part of the Nellis data analysis. The results suggest that there exists very little variation between basin systems that cannot be accounted for in terms of sampling stratum. (It is far more likely, however, that such differences, if they exist, will materialize only when the individual basins have been collapsed into a smaller number of meaningful basin types. This is due to the fact that the demonstration of statistically significant differences requires both a minimization of variability within categories and a maximization of variability across categories). Similarly, no differences were observed between geotechnically suitable and non-geotechnically suitable areas. This too would seem to reflect the substantial amount of variability, particularly within the latter category.

Site Clustering

Table 2.2.4.3-3 provides data regarding the clustering of prehistoric sites and isolates within the Nellis sample. The Clustering Coefficient, (Cc), provides a relative measure of site clustering that varies from 0 to 1 and is independent of relative sample size and mean (see Coombs, 1980). The Cc values shown in the table indicate no substantial differences between strata in terms of clustering (i.e., all show evidence of clustering), with the possible exception of the three strata ("well," "playa," and "unclassified mountain") for which the sample sizes are too small. This conclusion is further supported by the probabilities provided in Table 2.2.4.3-1 which indicate the likelihood that the most populous sample unit in each stratum is the result of a random distribution of sites within the stratum.

The notion that sites tend to cluster in space is given further credence by examining the co-occurrence of sites and isolates within sample units. There is, for example, a strong tendency for prehistoric sites and prehistoric isolates to be found in the same sample units. This association persists across all strata for which there exist usable data and is especially strong in the Northern Desert Shrub stratum. The pooled probability of this result is less than one in 250 (Table 2.2.4.3-4).

Similarly, historic sites and historic isolates tend to occur in the same sample units, although this pattern is not nearly so evident, due largely to the comparatively small number of historic remains recorded. However, historic and prehistoric remains do not exhibit this tendency to co-occur except at springs.

These results are essentially what one would expect to find. On the one hand, sites from the same basic cultural milieu tend to cluster in space, sometimes

Table 2.2.4.3-4. The spatial association of prehistoric sites and isolates.

PREHISTORIC SITES	PREHISTORIC ISOLATES		
	ABSENT	PRESENT	TOTAL
Absent	101(92)	42(50)	143
Present	53(62)	41(33)	94
Total	154	83	237

3983

$\chi^2 = 5.06$ $\rho < 0.025$

Expected values are shown in parentheses because they were contemporaneous and components of the same settlement and subsistence system and other times simply because they reflect foci on the same environmental resources. Sites representing vastly different cultures, on the other hand, do not cluster. Together, this evidence strongly suggests that we are looking at a real and meaningful clustering phenomenon.

Spring-Associated Sites

As noted above, site densities are unusually high in spring stratum sample units. This is true for both prehistoric and historic loci and both types tend to occur in direct association with the springs. Indeed, nearly half (8 of 18) of the spring stratum units have sites with both a prehistoric and a historic component immediately adjacent to the spring. This is a particularly telling statistic when we realize that only 11 other sample units in the Nellis sample contain both prehistoric and historic sites anywhere within their bounds (three of these are other spring-stratum units).

Table 2.2.4.3-5 shows the densities of prehistoric sites and isolates at various distance ranges within one mile of springs in the Nellis sample. It should be noted that the figures are high near the spring (the evidence indicates that this is not simply a by-product of sites located directly at the spring) and decline up to a distance of approximately 0.6 miles, at which point the densities appear to increase once more. This higher density region may extend to the one mile boundary and perhaps somewhat beyond.

It is noteworthy that this pattern of density decrease followed by increase also was observed in data from the California Desert (Coombs, 1979a) and has been noted by others (e.g., DRI, 1980, personal communication; Thomas and Bettinger, 1976). It may be that this is a result of the differential use of springs as hunting areas, on the one hand, and for water and plant resources, on the other.

The effect of springs on site densities at greater distances is not evident within the Nellis sample. That is, sample units located 2, 3 or 4 miles from the nearest spring do not appear to have higher site densities than those units located more distant still. Comparatively few sample units outside of the spring stratum lie in the immediate vicinity of a spring, however. Thus, this conclusion cannot be supported with particularly impressive statistics. Nevertheless, visual inspection of the cross tabulated data leaves one with the clear impression that within most strata (other than the spring stratum) prehistoric loci are more or less randomly distributed with respect to spring distance.

Habitation Sites

The distribution of sample units containing habitation sites is depicted in Table 2.2.4.3-6. The table suggests that such sites may be found in all strata (although none were recorded in the two strata represented by very small sub-samples, namely the "well" and "unclassified mountain"). Nevertheless, it would appear that sites of this type tend to predominate in areas associated with springs, pinyon-juniper stands and playa shore features.

Table 2.2.4.3-5. The distribution of prehistoric loci in the vicinity of springs.

DISTANCE TO THE NEAREST SPRING (MILES)	AREA COVERED (SQUARE MILES)	SITES AND ISOLATES RECORDED	ESTIMATED DENSITY
0.0 - 0.15	1.2	17	14.0
0.16 - 0.30	0.94	5	5.3
0.31 - 0.45	0.72	4	5.5
0.46 - 0.60	0.45	1	2.2
0.61 - 0.75	0.16	1	6.3
0.76 - 1.00	0.05	2	38.1

3984

Table 2.2.4.3-6. The distribution of prehistoric habitation sites.

STRATUM	HABITATION SITES ABSENT	HABITATION SITES PRESENT	TOTAL
Spring	9 (50.0)	9 (50.0)	18
Well	3 (100.0)	0 (0.0)	3
Lake Terrace	35 (85.4)	6 (14.6)	41
Playa	1 (50.0)	1 (50.0)	2
Playa Margin	18 (72.0)	7 (28.0)	25
No. Desert Shrub	46 (88.5)	6 (11.5)	52
Salt Desert Shrub	60 (96.8)	2 (3.2)	62
Unclassified Mts.	2 (100.0)	0 (0.0)	2
Pinyon/juniper	22 (68.8)	10 (31.2)	32
			3985

Row percentages are shown in parentheses.

Topographic Setting, Sampling Stratum and Site Distribution

As part of the present analysis, all sample units were classified according to a simple landform typology: 1) valley floor, 2) mid-fan, 3) pediment, and 4) mountain. To perform the classification, nominal definitions of each of the four classes were provided to a single laboratory assistant who then used USGS topographic map information to categorize each sample unit accordingly.

Obviously there is a strong relationship between this classification and the original stratification system. Nevertheless, there are differences between the two and it is instructive to examine these. We find, for example, that there is a strong tendency for sample units located in the three lacustrine-related strata (i.e., "playa," "lake terrace," and "playa margin") to contain prehistoric loci only if the unit lies within the "valley floor" domain. This association is depicted in Table 2.2.4.3-7.

This pattern is most likely due to the impression of the initial stratification (for which the Archaeological Research Center should not be faulted, for this kind of imprecision is an inevitable part of most stratification systems) and to the apparent fact that prehistoric site and isolate densities tend to be especially high in direct association with extinct lake features. That is, our crosscutting landform classification (the "valley bottom" domain in particular) has served to highlight and differentiate that region within the vicinity of playas which contains the greatest densities of prehistoric remains.

Previous research in the Great Basin has shown the transition zone between the upper bajada and the mountains to be one of especially high site density (e.g., Thomas and Bettinger, 1976, Lindsay and Sargent, 1978), but those studies have tended to be confined to relatively small study areas. The larger size of the Nellis study region provides an opportunity to explore the significance of this transitional zone further. Only three of the Nellis sampling strata contain significant numbers of sample units within the Upper Pediment and Mountain topographic settings. They are the pinyon-juniper, Northern Desert Shrub, and salt desert shrub strata. For present purposes the latter two strata are combined into a single stratum, the Desert Shrub Stratum. Table 2.2.4.3-8 summarizes the distribution of prehistoric loci from these two strata in upper pediment and mountain settings. When comparisons are made between strata, the pinyon-juniper stratum is found to have a higher percentage of sample units with sites in both topographic settings. Within-stratum comparisons show that, for the pinyon-juniper stratum, sites are most abundant in the upper pediment setting, while for the Desert shrub stratum, they are most common in the mountains. Figure 2.2.4.3-1 provides a basis for making a more detailed assessment of these differential site distributions. Within-stratum comparison shows that MA sites predominate in the upper pediment setting for the pinyon-juniper stratum. This suggests that this was the preferred locus of longer term occupations for exploiting pinyon nuts as documented by Steward, 1970 and Thomas, 1973. The desert shrub stratum has a predominance of LA sites in both topographic settings, but LA sites are most abundant in the mountains. Between-stratum comparisons further support the contrast between shorter term occupation within the Desert Shrub stratum and longer term occupation in the pinyon-juniper stratum. The behavioral significance of these different patterns are not explored further here. This discussion does serve to establish the need to explore in much greater detail the variability in the spatial distribution of archaeological resources within the study region. For example, for present purposes it has been necessary to assume that all foothill zone areas are of equivalent sensitivity in order to conduct the

Table 2.2.4.3-7. The distribution of prehistoric loci within the playa, lake terrace, and playa margin strata.

PREHISTORIC LOCI	TOPOGRAPHIC SETTING		
	VALLEY FLOOR	OTHER	TOTAL
Absent	20 (40.0)	13 (73.0)	33
Present	30 (60.0)	5 (27.0)	35
Total	50	18	68

3986-1

Column percentages are shown in parentheses.

Table 2.2.4.3-8. Site distribution in the upper pediment (UP) and mountain (MT) settings.

PREHISTORIC LOCI	SAMPLING STRATUM			
	PINYON-JUNIPER		DESERT SHRUB	
	UP	MT	UP	MT
Present	9(90%)	14(67%)	17(45%)	6(60%)
Absent	1(10%)	7(33%)	21(55%)	4(40%)
Total	10	21	38	10

4078

Column percentages shown in parentheses.

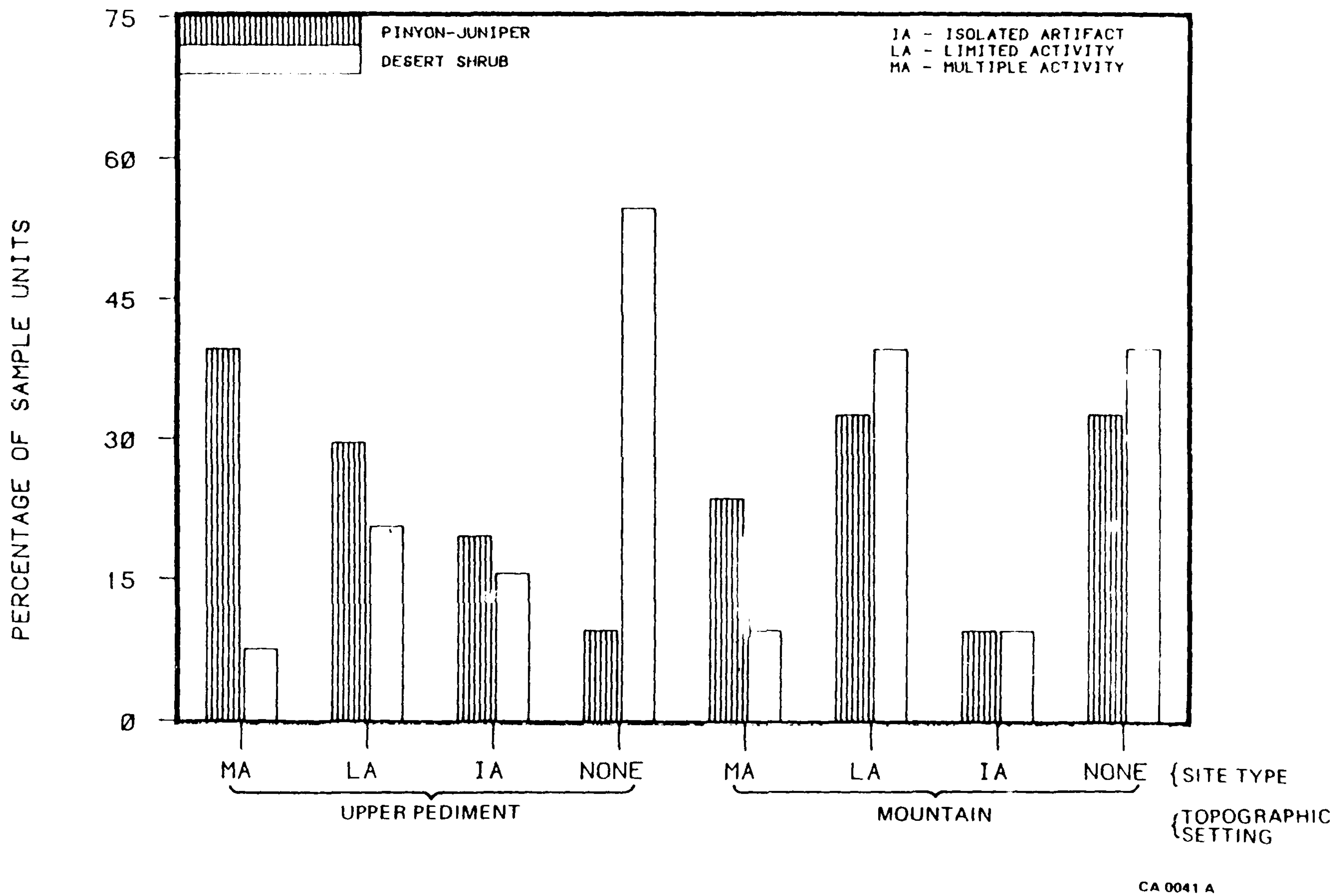

Figure 2.2.4.3-1. The distribution of archaeological site types in upper pediment and mountain settings.

region-wide impact analysis for part 4.0. The present information suggests that such an assumption may overestimate archaeological sensitivity in some cases while underestimating it in others.

Summary

Collectively, this evidence would seem to suggest that two loci of major prehistoric importance were the spring and the pediment area in direct association with juniper-pinyon stands. Habitation sites tend to occur at these locations and site densities seem to be noticeably higher. One would expect to find clusters of sites distributed out from these loci, reflecting well-developed and defined habitation and subsistence activities centered around them.

2.3 HISTORIC AND ARCHITECTURAL RESOURCES

This section provides an historical overview of the development of Nevada and Utah and the factors which contributed to the patterns of land use in each state. A typology of historic properties is defined for the Great Basin, and a review of the archival research currently being conducted is provided.

HISTORICAL OVERVIEW OF UTAH AND NEVADA (2.3.1)

The historical overview of Nevada and Utah is focused on developments that affected and shaped land use in the portions of the two states that will be affected by the deployment of the M-X system. Consequently, many important topics are excluded from this brief summary, in favor of discussions pertinent to understanding land use history and patterns.

Great Basin history can be divided into two periods: Spanish/Mexican and American. These two periods coincide with political developments that also signal major changes in regional land use The Spanish/Mexican Period lasted from the discovery of America in 1492 to 1848. The American Period began in 1848 with the acquisition from Mexico of the territory John C. Fremont had called the Great Basin. At the very opening of the American Period, the Great Basin was drastically affected in a "future shock" manner by the Gold Rush of 1849 and by the coincidental arrival of the Mormons in Utah in 1847. Their arrival at the end of the Spanish/Mexican Period placed the Mormons in the vanguard of Anglo-American impact on the Great Basin, and this occurred at the precise time that the region passed from Spanish/Mexican to American control. Thus, the division of the history of the Great Basin into these two periods reflects changes in the region's political, social and economic history.

Nevada and Utah share a similar history to 1850. The Great Basin was one of the last frontiers of continental United States to be explored by non-Indians. The history of the region during the Spanish/Mexican period is one of gradual penetration and discovery by people whose activities there covered the entire Basin. The history of these activities pertains to one ecological region, not to separate political entities.

I. SPANISH/MEXICAN PERIOD: 1492-1848

A. Spanish/Mexican Exploration 1540-1825

Spain laid claim to the American Southwest following the discovery of the New World by Columbus in 1492, and subsequent voyages of discovery

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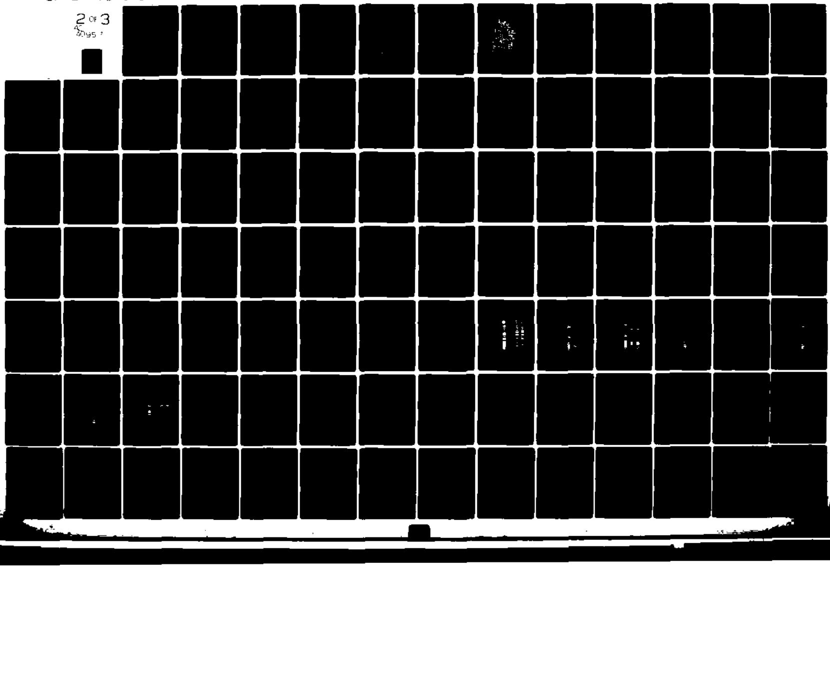

explorations made by Pizarro, Cortes and others. By 1540, Don Francisco Vasquez de Coronado had explored from New Mexico overland all the way to Kansas, while Hernando de Alarcon attempted to rendezvous with Coronado by way of the Colorado River. Failure of these expeditions to locate great wealth of silver and gold or land with good agricultural potential caused the Spanish government to write off the region as unproductive. On Spanish maps for the next two hundred years, the region was labelled "Land of Northern Mysteries" (Cline, 1963), although the Spanish continued to place mythical mounts of silver and interior rivers on maps, attesting to the persistence of the belief that there were such phenomena somewhere in the land north of Mexico.

Little attempt was made to explore the "mysteries" of the northern territories. New Spain pushed its frontier only as far as Santa Fe (1610) and coastal California (1769) in the two centuries following Coronado's and Alarcon's expeditions. Finally, in 1776, an attempt was made to open up a route through Utah and Nevada and join together the frontier outposts of Monterey, California and Santa Fe, New Mexico. Two Franciscan monks, Fray Atanasio Dominguez and Fray Silvestre Velez de Escanante, and a small party of civilians set out from Santa Fe in the summer of 1776. They headed north, following routes known by traders and fur trappers passing into unknown territory in southern Colorado. The expedition pushed northward as far as Utah Lake, where they turned south to avoid the searing Great Salt Lake Desert. In southern Utah, the men became discouraged by their evident distance from the California coast and by the hardships of the trail. The party turned easterly in southern Utah, crossed the Colorado River and returned to familiar territory in early winter of 1776. The diary of this epochal journey has been translated and interpreted several times in the 20th century. The most recent work (T. Warner, 1976) includes the best information to date on the exact route of the expedition.

The diary of the Dominguez-Escalante expedition and the map made by Miera, one of the civilians who accompanied the party, became important sources of information for Spanish traders in the years that followed. Contact was maintained with the Utes for trade in goods and slaves, and prospecting parties also moved northward into the Colorado/Utah region. Much of the Dominguez/Escalante route became known to these New Mexican enterpreneurs, but no one succeeded in travelling from Santa Fe to the missions of California until American fur traders had first bridged the gap between southern Utah and southern California's Mojave River. This important event occurred in 1826-27, after political control of the region had passed from Spain to Mexico in 1821.

B. Fur Trappers 1826-40

American, British and French-Canadian fur trappers began moving into the Rocky Mountain and Northwest Coast areas in the early 19th century. Some Americans and French had also become established at Santa Fe. By the mid 1820s, the Hudson's Bay Company of Canada was locked in economic combat with the American trappers who sought to dominate the fur market. Peter Skene Ogden of Hudson's Bay Company first entered the northeast Great Basin in northern Nevada in 1826. In the next few years, he deliberately set out to trap all the fur bearing animals found along any streams so that the Americans would be kept out of the

Pacific Northwest (Elliott, 1973). Ogden is generally credited with discovering and naming the Humboldt River and many of its tributaries, the Humboldt Sink, Walker Lake and, incidentally, demonstrating that the legendary San Buenaventura River of the Spanish map makers did not exist.

American Jedediah Smith, partner in the Rocky Mountain Fur Company, in late 1826 set out to discover a new route to the California coast, which could provide a direct connection with China, the world's chief fur market. Smith and his colleagues were trapping the northern Rockies that year. He and a small party of men left the fur rendezvous at Cache Valley, travelled south through Utah along the western foothills of the Wasatch Range, moved into Nevada via the Virgin River which they followed to its junction with the Colorado. They then crossed the river, made their way to the Mojave Indians at Needles, and finally into southern California by way of the Mojave River and Cajon Pass. Smith eventually led his men into the San Joaquin Valley, and departed from that place to rendezvous at the 1827 gathering at Bear Lake in Northern Utah. In a truly astounding feat, Smith and his two companions made their way across the trackless central Nevada Great Basin, arriving back at the rendezvous in July 1827 via the Great Salt Lake Desert. He returned to California via the Southern Utah-Virgin River route later in 1827, and did not again pass through this part of the Great Basin (Brooks, 1977).

A significant expedition made by American fur trappers in 1833-34, the Bonneville-Walker party, was sent under the command of Joseph Reddeford Walker to explore a route to California. Political overtones have been ascribed to this party (c.f. Todd, ed., 1961). Walker made substantial contributions to knowledge of the Great Basin, and many "firsts" have been identified, among them that his was the first party of non-Indians to make a round trip from the Great Salt Lake to the Pacific by way of the Humboldt River (Elliott, 1983).

This history of exploration of the Great Basin by mountain men and fur trappers is not well documented because the men themselves did not record their findings. Many frontier trappers located in the Rocky Mountains and other western localities knew the basin and undoubtedly were the "first" to discover many of its features. Little has come to us in the written record to substantiate these discoveries. Jim Bridger, Etienne Proveaux, Peg-leg Smith, Old Bill Williams, Miles Goodyear, Kit Carson and many others established trapping circuits in the Utah-Nevada Great Basin during the years of the fur trade. Bill Williams and Goodyear located in the vicinity of the Great Salt Lake but left little information on their activities.

C. New Mexican Trade, 1827-1848

Smith's successful foray across the southern Great Basin to Nevada and eventually the Mojave River in California forged the final link in the long-sought route between Santa Fe and Monterey, California. While other trappers and traders continued to ply their goods in the Rocky Mountains, traders from Santa Fe now began to send wares to California via pack train over a route which became known as the "Old Spanish Trail." The commerce was conducted seasonally, with woolen goods the primary trade object brought from New Mexico to trade for the fine horses and mules available in California. The commercial traffic began in 1829, when Antonio Armijo led a caravan to Los Angeles. William Worfskill and George C. Yount in 1830-31 modified the Armijo route swinging farther north into Utah via the old trail of Dominguez and Escalante. They entered western Utah at Spanish Fork before heading south in the footsteps of Jedediah Smith. Users of this trail included not only legal commercial caravans, but illegal slave and horse traders. The slaving raids on the Paiute and Goshute bands of Utah and Nevada decimated those populations and caused long-lasting reactions of fear and hostility until the raids were finally stopped in the 1850s. Raids were made both by Ute Indians and by New Mexican traders who came up from Santa Fe. The commercial traffic along the trail came to an end in 1848, when the region passed into the political control of the American government (Hafen, 1954, Warren, 1974).

D. American Exploring Expenditions

While the Bonneville-Walker expendition of 1833-34 had hidden military objectives, the John C. Fremont excursions of 1843, 1844, and 1845 into the Great Basin clearly were intended to provide information to the U.S. on the nature of the Mexican lands in the west (Nevins, 1956). Fremont's 1843 trip took him into northwestern Nevada and across the Sierras to California. On his return to the States in 1844, he searched out the "Great Spanish Trail" through the Mojave Desert, cut north to southern Nevada which he entered in southern Nye County, crossed present day Clark County and into Southern Utah via the Virgin River route. He abandoned the "Spanish Trail" in central Utah and moved northward into Salt Lake City. His report of this expedition cleared up many of the legends about the nature of the unexplored desert west of the Rocky Mountains. His report and particularly the map by Preuss which accompanied the report was the first to designate the region the "Great Basin" and he named many of its features.

In 1845, Fremont again explored the Great Basin, this time at its northern end. He spent several days at the Great Salt Lake, crossed the salt flats to eastern Nevada's mountains, and explored the Humboldt and the riverless central Nevada area by splitting his party in two and arranging a rendezvous at Walker Lake. In 1853, on his fifth and last expendition into the West, Fremont crossed Utah and Nevada again, this time moving west from the Cedar City area to the Pioche region, then crossing the Nevada Test Site to Beatty and moving westerly into California. The reports and maps filed by Fremont and other members of his parties contributed immensely to an understanding of the nature of the Great Basin, routes to cross it, and obstacles to travel. The information published about the 1844 expedition in particular was made available to the American public just in time for the immense migration of 1849. Unfortunately, some of the 1845 expedition evaluations were overly optimistic about the hazards of travel across the Salt Lake Desert, and travellers who chose that route frequently came to grief and had to abandon wagons and animals in their flight for survival. Lansford Hastings' famous guide for overland emigrants used the Fremont route as a shortcut but few travellers were as lightly loaded as Fremont, and many suffered terribly from following in his footsteps (Kelly, 1930).

E. Overland Emigration

Overland emigration through the Great Basin during the Mexican Period began as a trickle in 1830 and swelled significantly by the end of the decade. The earliest such emigration barely touched the Great Basin. Emigrants moved from Santa Fe to Los Angeles via the Old Spanish Trail through Utah and Nevada, and Arizona as early as 1830-31 with the Wolfskill-Yount party. In 1837, the Slover-Pope parties brought wagons successfully to California via this trail, but little is known of the excursion.

Travel into northern California, Oregon, and Washington moved along the Humboldt River beginning in 1841. This Humboldt River route was the best known trail across the Great Basin for travellers originating in the States. Several shortcuts were routed, notably Hastings Cut-off across the Great Salt Lake Desert, and the Applegate-Lassen and Nobles shortcuts at the western end of the trail. The ill-fated Donner Party of 1846 followed the Hastings Cut-off, wandered around northwestern Nevada and the Ruby Mountains before regaining the main trail down the Humboldt. Their delay proved fatal to the group; and was an important deterrent to travel over the Humboldt Route for some time after their trails became known (Elliott, 1973).

F. Settlements

Throughout the Spanish/Mexican Period, there were no permanent settlements at all made in the Great Basin of Utah and Nevada. The first settlement other than the isolated cabins of mountain men in the vicinity of Ogden and Provo was the City of Salt Lake. The establishment of this city, while it occurred in 1847 and thus within the Mexican Period, rightfully belongs to the American Period in terms of the origins of the settlers and their role in the unfolding history of the region.

II. AMERICAN PERIOD

A. Communication: Emigration and Commerce

Communication networks that developed in support of the communities of the Great Basin connect Nevada and Utah with each other and with other parts of the region. The history of the development of these networks is best handled regionally, rather than by individual state (Figure 2.3.1-1).

1. Humboldt River Route

In the year following the discovery of gold in California in 1848, overland emigration swelled to a tidal wave from the trickle noted in the Mexican Period. Thousands of people poured west by wagon and on foot, churning the trails into dust, their animals using up all available forage, polluting the water and generally raising havoc with the Great Basin ecosystem. This, in turn, had great negative impact on the native population of the region.

2. Spanish Trail/Mormon Road

Most 49ers who crossed Utah and Nevada travelled via the Humboldt River route. Some, who arrived in Utah too late to cross the Sierras in winter, opted for the southerly Spanish Trail route. An offshoot group of the first wagon train party to use this trail, then poorly known by Americans, became known as the Death Valley 49ers. They tried to shorten the route by cutting off from the trail at Mountain Meadows in southern Utah and heading directly westward. This route led them through very rough and waterless wastes, and finally into Death Valley itself. Their escape from this extraordinary place has been made famous and is covered in

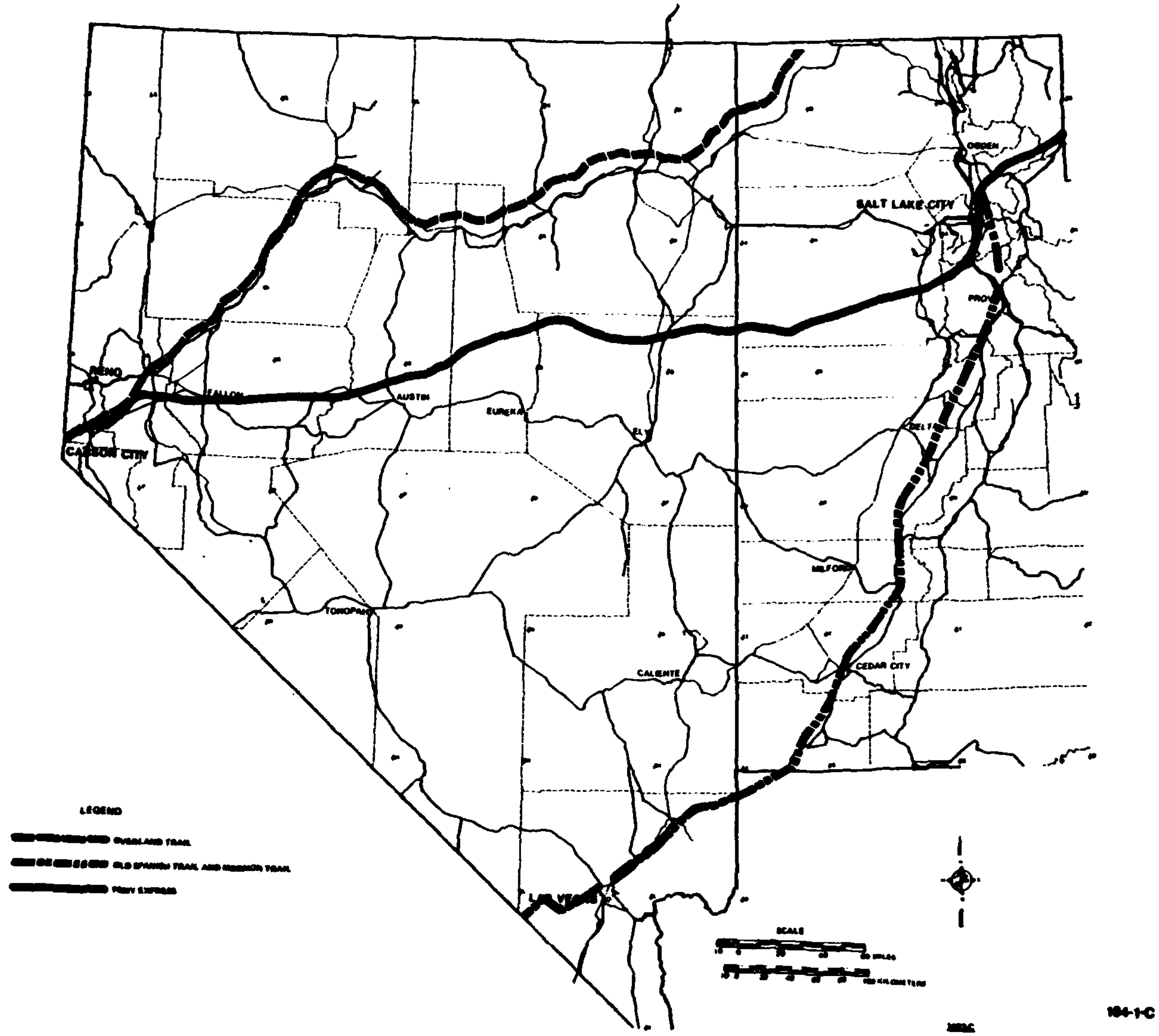

Figure 2.3.1-1. Historical trails through the Nevada/Utah study area.

great detail in literature. It is usually forgotten that they were but a single splinter group of a party that made it safely to California with no loss of life by following the established Spanish Trail through southern Nevada.

The Humboldt Trail continued as the major overland emigration route until a route across Central Nevada was opened in the mid to late 1850s. Freighting between Salt Lake City, which was founded in 1847, and coastal California was developed extensively in the 1850s by Mormon teamsters. Their preferred route was the southerly road that was developed on the Old Spanish Trail through Utah, but which made extensive modifications through Nevada and California. This Mormon Road was used by hundreds of wagons conducting commerce between the Rocky Mountain West and California coast, and was perhaps the major connection between the two regions until the 1860s.

3. Central Route

Howard Egan, a Utah resident, engaged in stock raising and marketing, pioneered a new route across the Great Basin in the mid 1850s. No significant use was made of this new, shorter route until the end of the decade, when both the postal department and the military became interested in shortening the roundabout Humboldt River journey. In 1859, the mail route was moved to his new central route and for that year a special express was established that has lived on in deserved glory as the Pony Express (Figure 2.3.1-2). With stations built at ever closer intervals over the next several years, this route became the heaviest travelled route connecting Sacramento and Salt Lake City, and was served by both express and regular mail carriers, stage and freight lines. Along this route some of the first ranches in the Great Basin were established in order to serve the needs of the horses and men who worked the line. Military bases were also established along this trail to protect the traffic from Indian depradations. The earliest military bases in the Great Basin include Camp Floyd in Utah (1858), Ruby Fort (1862), and Fort Churchill (1861) in Nevada and all were located along the central route.

The transcontinental telegraph line was constructed in 1961 parallel to the Central Route. Its completion signalled the end of the Pony Express, which was then no longer the swiftest mode of communication between east and west.

4. Rail Communication

Rail communication was opened up through the west via the Humboldt River. The Central Pacific Railroad was constructed through Nevada from California to meet the Union Pacific being built to the west from Omaha. Their junction occurred at Promontory Point, Utah, in 1869. Completion of this rapid transportation system opened up vast new areas to commerce, mining and settlement, and caused relocation of regional networks of supply and communication. No other regional rail line was constructed that opened up to development new areas of the Great Basin until the 20th century, when the San Pedro, Los Angeles, and Salt Lake Line was constructed through southern Nevada. This line tied together coastal California at Los Angeles, with the Union Pacific's lines in Utah. The commercial and mining development of this region boomed as a result (Myrick, 1963).

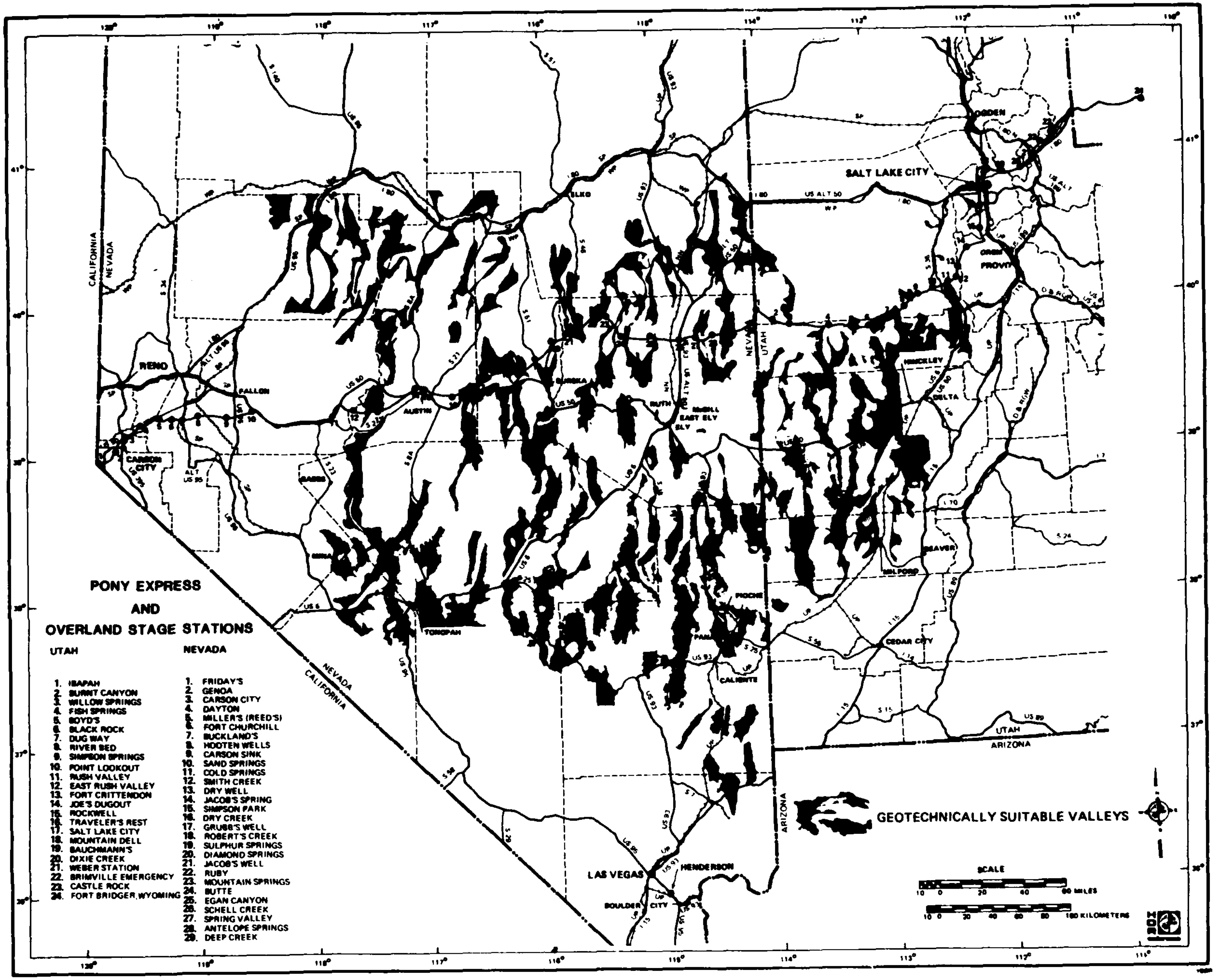

Figure 2.3.1-2. The Pony Express and Overland Stage stations in Nevada/Utah.

5. Automobile Roads

Automobile roads linking the Great Basin with the rest of the nation were a relatively late development. The Midland Trail was the first to receive national attention, designated as a major transcontinental route in 1916 (National Midland Trail Association, 1916, rep. 1969). The route followed the old Central Nevada wagon road. In later years, much of the old Midland Trail was incorporated into the Lincoln Highway, the first paved transcontinental highway in the U.S. It is interesting to note that part of the Pony Express route of 1860 became the route of travel of America's motorists in the twentieth century.

B. Settlements

Analysis of the pattern of settlement of Nevada and Utah Great Basin regions reveals significant differences in the motivation for settlement and types of communities that were founded. These differences reflect major differences also in the kinds of people who settled each region and imparted to each region a characteristic flavor.

1. Utah

In the early years of settlement of the Great Basin, distinctive patterns were established in Utah that are detectible some 130 years later. The Mormon geopolitical strategy, adopted as a result of their lengthy period of persecution in New York, Ohio, Illinois, and Missouri, was to emigrate to an unpopulated region of the West, where they could become established before any other people had come to claim the land, where they could be the first to develop industry and commerce, and where their unpopular religion could mature without pressure from neighboring competitors. Once situated in Utah, the Mormons acted to fill up the agriculturally promising lands with their own people, effectively closing out non-Mormon ("gentile") settlement (cf. Day, 1968: 233-4).

The Mormons responded to perceived threats to the well-being and security of their Rocky Mountain kingdom in a variety of ways. The first threat recognized was the sheer number of emigrants to California attracted by gold. These people could overwhelm the small, vulnerable frontier settlements by their demands for food and draft animals. They might antagonize the Indian population against their new neighbors, and Mormons were instructed by their Church elders to win over the Indians with biscuits not bullets. Other social mechanisms for enlisting the support of the Indians included intermarriage with Indian women and adoption of Indian children. In some cases, the latter was accomplished by a form of purchase from the Indian parent or the slave trader. Men who learned the Indian languages well and who were able to trade with them were called to perform missions of interpreting and trading with the Indians in the interests of establishing a permanent bond between the Mormons and Indians. The Native Americans of southern Utah and Nevada learned to distinguish between "Americans" and "Mormons", and generally harassed the former but not the latter (Korn, ed., 1954; Jensen, 1926).

Until 1869, the Mormons were able to develop in isolation in their mountain retreat. With the arrival of the transcontinental railroad, however, the Church feared that the solidarity of the people would crumble in the face of the appealing new consumer goods that would become available, that the people's limited supply of money would be spent on unneeded items, that debt would dog their heels, and the Mormon community would collapse. The Church elders met in council to plan how to overcome this extraordinary threat to the community, and planned a two-pronged approach to the problem. First, the Church established its own mercantile institution that would act as a central agent for all goods entering or leaving the Mormon community. In support of this centralized business, each Mormon community would also open a cooperative store where goods could be brought from the community and exchanged for manufactured goods that had been imported via rail with ZCMI as agent. All Mormons were asked to buy and sell only through the Co-ops, so that the entire community of Mormons would benefit from this centralized activity (Arrington, 1958).

Secondly, the Women's Relief Society was organized to provide assistance to families that were in need, and to encourage the women to forego fashion and frills in favor of solid frontier necessities. Women who bought yard goods from the east rather than home-made products were subjected to severe social pressures to comply with the wishes of the church and make their own. Women were encouraged to grow, spin and weave cotton, linen, and woolen fabrics, and to make their family's garments from these materials. Silk worms were imported and mulberry trees planted to provide food for the worms, in an attempt to produce not just the homespun fabric for everyday use, but fancy goods. During this period, luxuries such as tobacco, coffee, and sugar were frowned upon. Sugar was eventually produced by processing sorghum and later sugar beets, but tobacco and coffee became substances whose non-use by Mormons continues today.

Eventually this close-knit society did weaken somewhat, and the hold of the church over its members in economic matters lessened. However, there is still a strong emphasis today placed on the "communal good," with self-reliance instilled into all Mormon families and strong pressures for each family to provide for its own survival. Two years worth of foodstuffs and basic necessities should be stored by each Mormon household in case of civil insurrection or some other disaster. There is still a widespread economic network that provides the products of one region to the church members of another region through a barter system. Mormons tend to prefer to deal with one another in economic and social matters as well as religious ones, and Mormon communities still do not welcome outside influences (Lake Mead Monitor, July 17, 1980, p. 2, Col. 2-3).

Politically, the Church is still a powerful force in Utah as well as Nevada, despite the growth of the non-Mormon population (Louder and Bennion, 1978). Part of the reason for this is that the Church emphasizes voting as one of the examples of good citizenship. All members are urged to vote, and the percentage of voters among the Mormon population is higher than among non-Mormons. Consequently, the Mormon influence is proportionately greater than their numbers might otherwise indicate.

Mormonism began as a utopian religion of early 19th century upstate New York farmers. Later, converts to the Church of Jesus Christ of Latterday Saints were drawn primarily from the populations of Northern Europe, Scandinavia, and the British Isles (Louder & Bennion, 1978). This fact has had important consequences on the ethnic makeup of the Mormon population, and on its religious tenets. The first blacks encountered were either slaves or freed slaves, and their low social status was reflected in Mormon doctrines regarding the position of blacks in the Church hierarchy. Only in the past few years has the Church, by revelation, discovered that the time is right to allow black members to advance to the priesthood and take a full role in the Church hierarchy. Indians, on the other hand, were regarded as descendants of the "Lost Tribes of Israel," and were to be accorded every opportunity to learn the message of the Book of Mormon and to gain salvation through adopting its precepts. Indians were afforded special treatment.

The Mormon pioneers were often destitute people. Some had been reasonably well off financially before they were harried out of their homes in the east. Others, particularly converts from Great Britain in the 1850s, were too poor to be able to afford the costs of emigration to the U.S. The Church set up a fund to assist these people to come to Zion on the shores of the Great Salt Lake, and many of them were members of the various handcart caravans that plodded across the plains from St. Louis. The poverty experienced in the pioneering years on the American frontier was no greater than many had experienced in their homelands. The impact of those difficult years had important ramifications for the Mormon community, stressing the value of cooperation and mutual support in the face of all kinds of adversity. It also had lasting impact on encouraging the virtues of thrift, frugality, and careful use of resources, particularly manufactured items. Recycling has always been a way of life on the frontier, and it was especially important in the Mormon communities.

Undoubtedly the most important Mormon custom that had the greatest impact on its developing community, and the relationships between the Mormon community and the rest of the nation, was the practice of polygamy. This custom placed the entire Mormon Church outside the accepted marital and family practices of the American nation and of most of the European communities which were the source of converts. The custom so antagonized the American people that the people of Utah were not permitted to attain statehood until 1896, despite their considerable population. Only after the issuance of the Woodruff Manifesto in 1890 that foreswore the practice, was the United States willing to entertain the petition of Utah for elevation to state status.

While the practice was disavowed in the late 19th century, polygamy persists in isolated pockets of the Great Basin. Within the region of Utah directly impacted by the M-X, some polygamous communities are found. There appears to be no move on the part of the state or federal government at this time to take any punitive measures against the people of these communities.

In most of the area to be impacted by the M-X missile deployment, agricultural settlement was made in later waves of Mormon dispersion from the Salt Lake City-Mormon Corridor. In the western desert region of Utah, the land was agriculturally less valuable and would support only a smaller population. Mines operated by non-Mormons provided temporary attraction to outsiders, whose large numbers swelled the county censuses for a few years and then left when the boom was over. Persistent settlements in this area include railroad towns as well, which have survived boom and bust cycles because they have come to serve a variety of needs in a dispersed area. Only with the competition from trucking in the last 25 years has there been much decline of traffic at the rail centers. With the current energy shortage, rail centers may well see renewed activity at the expense of trucking.

Utah was pioneered by the Mormons in 1847, when the vanguard of settlers arrived in Salt Lake Valley. For the first twenty years, all Utah settlements radiated out from the Salt Lake headquarters. Only Camp Floyd and Camp Douglas, military bases established in 1858 and 1862, respectively, were exceptions to this fact (Peterson, 1978). Mormon settlements were first and foremost agricultural, and secondly they were villages. Isolated ranches were not added to the Mormon landscape until after 1868, when federal homestead laws were applied to Utah (Peterson, 1978). Mining camps were attempted by non-Mormons ("gentiles") in 1864, but did not persist. A solitary river port was attempted at Callville on the Colorado River, but it was abandoned within three years of its founding (Rosenvall, 1978:59).

The chronology of Mormon settlement of Utah reflects the need for support of traffic along the Mormon Road between Salt Lake City and coastal California. In 1851, the Mormons purchased land in California and established the community of San Bernardino as the western terminus of the road linking Salt Lake to the coast via the all-weather route of the Spanish Trail. As traffic increased along this road, settlements were established at key stock forage and watering spots. Although a few people had begun individual ranches at a few spots before the towns were begun (as at Lehi and American Fork), by 1850 these gave way to town settlements planned and engineered by the Church elders. The Mormons' penchant for cooperation and their Church's recognition of the desirability of cooperative settlements on the raw frontier combined to favor farming communities over individual isolated holdings.

This Mormon "penchant" for cooperation (Peterson, 1978, p. 94) was fostered by the persecution experienced by members of the Church in the years of the developing religion in the East. Forced to rely upon one another and to survive economic, social, and political, as well as religious persecution and ostracism, the Mormons had become thoroughly communal in orientation by the time they arrived in Utah. The strength of the ties that bound them together in the face of adversity continued to function in their new homes in the west, as they strove to overcome natural and social forces that threatened their survival. The trust they placed in their religious leaders, who perforce became social, political and economic advisers as well resulted in a mostly unwavering support of the wishes of the Church hierarchy.

It was then, and still is, the custom of the Church to send its people on special missions for the benefit of the entire populace. Such missions might be to convert new members and bring them "home to Zion," to locate and exploit particular natural resources needed by the community, especially resources that would enable the group to become self sufficient and economically independent of the capitalists of the east, to convert and pacify Indians who lived adjacent to the wagon roads that were the lifeline of the isolated communities, or other, desirable activities. The Church decided when and where settlements would be made, who was to go and what the purpose of the settlement would be. The design and economic focus of the community were set forth also. In the period 1847 to 1900, 497 communities were established in this manner in the U.S. While some 69 or 13.9 percent have failed, the remainder still persist despite modern chang and population shifts (Rosenvall, 1979:52).

a. Agriculture. In the area under consideration here, settlements were begun along the "Mormon Corridor" (the trail through Utah to San Bernardino) as early as

1849. Parowan, considered the headquarters for settlement of southern Utah, was established in 1850, and Cedar City was begun as an iron smelting experiment in 1851. Other smaller settlements were established at regular intervals along the trail, with ten miles considered the ideal distance apart although there was variation from this (Peterson, 1978:94).

The Church advised the settlers to build fortified villages for greater security. These "forts" were places of defense for the infant settlements. In time, people would move out of them to build homes, but ideally all still within a large, four-square complex. The distinctive settlement pattern of the Mormon community on the frontier, very European in its organization, consisted of a nucleus of homes with gardens and barns, outlying small agricultural plots assigned to individual families, and larger hay and grazing fields utilized by everyone in common. Still farther removed were the "big range" areas for dry stock, Church cattle, off-season oxen and cooperative herds. Minerals, building stones and timber, also used for the common good, were not individually claimed (Peterson, 1978:95-6).

In 1855, a new wave of settlements was sent out to the very borders of "Deseret," as the Mormons called their territory. A mission was sent to Mormon Station in western Utah (now Genoa, Nevada) which had earlier, transient beginnings as a trading post operated by Mormons from Salt Lake. Renamed Genoa, the community brought the first attempt at government by Mormons, in whose territory the town was established but who were at odds with the gentile faction of the town. A mission was also sent to Las Vegas, then to New Mexico Territory, and a fort was built there. The men were occupied with farming, assisting travellers on the Mormon Road, and pacifying the Indians by teaching them to farm. In both instances, Mormon occupation ended within a few years. In the case of Genoa, the Mormons were recalled to Utah at the time of the "threat" of Johnson's Army in 1857. Las Vegas was abandoned by the Mormons in early 1857, prior to President Buchanan's decision to send the army to Utah. Las Vegas Mission failed because of internal conflict over leadership, the reluctance of the men to be apart from their families in Utah, and demoralization over their failure to convert the Indians to Mormonism or to farming.

New settlements were sent out in 1864, with missions sent to the Muddy River in what was then Arizona Territory, and to remote valleys on the western frontier of the Territory of Utah. These valleys were taken from Utah and Arizona in 1867 and added to the state of Nevada, so that the settlers of the Muddy, Panaca and Spring Valley found themselves owing taxes to Nevada. Only Panaca residents remained in their community; the other settlers moved back to Utah Territory.

Colonizing efforts of this type were attempted by the LDS Church of Nevada as late as 1890s, but the efforts were given up by 1900 (Arrington, 1958).

b. Commercial. Until 1869, the only Mormon attempt at a commercial establishment other than those incidental to the agricultural plan and millsites dependent upon agricultural produce was the river port at Callville. Callville, the county seat of Pah-Ute County, Arizona, before the land was taken from Arizona Territory and given to Nevada in 1867, was located along the Colorado River a few miles above the mouth of Las Vegas Wash. Here the Mormons hoped to establish a river port that would expedite overland emigration to Salt Lake City by permitting converts to travel tothe interior by Colorado River steamer. A river port would also decrease the cost of importing goods from the coast by the laborious overland wagon travel. The warehouses were scarcely built before the town was abandoned in 1867. The transcontinental railroad was nearly completed then, and the Mormons turned their attentions to luring the railroad to connect at Salt Lake City.

Salt Lake City was always the center of commerce for Utah because of its location at the junction of several wagon roads. Although the city did not succeed in making a direct link to the main line of the railroad, Ogden was designated the junction point after the Mormons donated the land to the railroad for use as a depot. The proximity of Ogden to Salt Lake enhanced the latter's status as commercial center.

An early Utah railroad town that was the "gentile" town of Corinne, north of the Great Salt Lake. This town never prospered following the selection of Ogden, a Mormon community, as the railroad's important shipping and junction point. Other railroad towns in Utah originally were almost entirely Mormon, since the Church and Brigham Young sponsored and paid for the subsidiary lines. After the lines were acquired by non-Mormon purchasers, beginning in the 1870s, service was extended to mining areas that were not dominated by Mormon residents. Few achieved any size.

c. Mining. The strong desire of the Mormon leadership to achieve economic independence led to strenuous efforts to mine and process ores that were essential to the community. Iron was a commodity always in short supply on the frontier; few iron relics remain from the many wagons that were abandoned along the trails because the iron was reworked by later passersby. For example, the gates at the Las Vegas Fort were fitted with iron reworked from abandoned wagons at a popular camp site along the Mormon Road (Jensen, 1926). In 1851, the Iron Mission was established at Cedar City, but because the Mormons lacked sufficient money and equipment, the project failed within a few years (Arrington and Weller). In 1856, the Las Vegas Mission was expanded to accommodate a lead mining operation in the nearby mountains. This project, too, failed, because the ores were too "refractory" for the mining techniques of the day.

Other than these and a few other primitive mining operations operated by the Church for its own benefit, the Church hierarchy discouraged its men from trying to prospect and mine gold, silver or other precious metals. The Church, in fact, so succeeded in closing off all of Utah to this popular "gentile" activity, that Patrick Conner, chief of military operations in Utah during the early 1860s, made it his business to ensure that mining was begun so that the Mormon "stranglehold" on Utah could be broken (Peterson, 1978:94). Connor founded Stockton and Bingham in northern Utah in the mid 1860s. Mining was regarded by Brigham Young as a frivolous activity that caused only grief, and a man who insisted on prospecting and mining was pressured to leave the community. There is some evidence that the claims made by Jacob Hamblin and other Mormons in eastern Nevada in the 1860s may have been attempted on behalf of Church interests in securing all the good claims to prevent gentiles from coming into the territory (Townley, 1973).

Mining eventually did become an important industry in Utah following railroad construction which opened up the territory in the 1870s. Rail lines were extended into southern Utah by the 1880s, supporting mining in southern Utah and eastern Nevada. Generally, non-Mormons operated the mines and Mormon farms supported the mining communities.

d. Military. Camp Floyd, about 30 miles south and west of Salt Lake City, was established in 1858 by Col. Albert Sidney Johnson, leading the troops sent by President Buchanan to escort Utah's first gentile governor to take up the reins of government. The camp had important impact on Utah, partly because the military forces paid cash for their supplies provided by the Mormon farms surrounding the area, and partly because it was located at one end of the Central Route across Nevada to California. Consequently, the mails, freight, and other commercial traffic between Salt Lake City and Sacramento passed by the camp, and this traffic was protected by the military forces assigned to the base. Hay fields and stock grazing lands were set aside by Johnston as military reserves, displacing some Mormon activities in Rush and Skull valleys. When the camp was abandoned at the outset of the Civil War, the materials were auctioned off at very low prices to the Mormon residents of Utah, providing them with numerous wagons, cooking utensils and other gear that was hard to obtain on the frontier.

In 1862, Major Patrick E. Conner was ordered to Salt Lake City to establish a second base ostensibly to protect the mails and travellers on the Central Route. Conner also regarded it his duty to open up Utah to loyal Americans, hostility being very high at the time between Mormons and gentiles. The Union Vidette, the first non-Mormon newspaper in the territory, was started at the base by Connor's men. The Vidette counteracted the heavily Church-oriented Deseret News. Camp Douglas was built by Conner on a beach at the east boundary of Salt Lake City; he rejected Camp Floyd as too far from the action. Despite advance misgivings, there were only minor incidents that gave cause for alarm concerning the Mormon/Gentile relationships. Conner's men did succeed in putting down Indian threats to the mails and overland emigration, and in their spare time prospected for precious minerals (Rogers, 1938). Their search was rewarded in 1864, and small but active mining camps were opened at Bingham and Stockton. These camps soon dwindled and became inactive, for the areas required expensive processing and there was no ready, inexpensive transportation to get them to market. Upon completion of the transcontinental railroad in 1869, this picture would change, and eventually even low grade ore bodies could be worked profitably.

Military activity in the Utah area during the 19th century included a number of official exploring and road construction expenditions. Surveys that were either military in nature, or were escorted by the army, included the Stansbury Expedition of 1849; Steptoe, 1855; Simpson, 1859; and Wheeler, 1869. Railroad surveys of the Utah area included the Gunnison expedition of 1853 in which Gunnison was killed by Indians in the Sevier Lake region. The project was completed by Captain Beckwith. The John C. Fremont railroad survey of 1853 also ended in tradedy, with accusations of poor leadership. This survey party became lost in the deep snows of the Rockies, resulting in cannibalism and death. The Simpson expedition was credited with opening up a shorter route between Salt Lake and Sacramento. Simpson followed the Egan route across Central Nevada, found it was by far the best, shortest and most efficient route, and it subsequently was officially adopted as the mail route for the Pony Express.

After the close of the military explorations of the mid-19th century, there was little military activity in Utah until the mid-20th century. When the U.S. went to Europe and Japan, Utah's open spaces appealed to the military for training and proving grounds, and military reserves were set aside for this purpose. These reserves have been continued and expanded. Hill Air Force Base and Dugway Proving

Ground are examples of this use. The Topaz Camp was established as a relocation center for Japanese-Americans during World War II.

e. Political capitals. Territorial seats of Utah were Fillmore and Salt Lake City. The first capital was Fillmore, but by the mid-1950s, it was obvious that it was too far from the center of commerce, and the capital was moved to Salt Lake City. County seats were designated as the counties were established, and these have remained to the present day.

2. Nevada

In contrast to Utah, Nevada was not settled in accordance with any scheme nor by any one socio-political group. Nevada's role throughout the early years of the American Period was primarily as bridge to California--not a pleasant trip, and one to be endured, not enjoyed. Nevada was not a destination for anyone; its mountains, deserts, and Indians all discouraged settlement in favor of better watered climes and above all, the gold country of California.

Nevada was created out of land divided between the territories of Utah and New Mexico as a result of the Compromise of 1850. New Mexico Territory received all land south of the 37th parallel, and Utah Territory all the land to the North. The trails described previously wound through Nevada, linking the Wasatch Front with coastal California, and thus bringing travellers through the Great Basin and Mojave desert of Nevada without enticing anyone to settle there.

Nevada's first settlement occurred at the base of the Sierra Nevada Mountains, relatively well-watered country which provided forage and timber for the wagon trains prior to their last big push across the mountains to Golden California. In 1850, a trading post was established at a site that later was named Genoa. Within a few years, a small community had developed around the post, which had changed hands several times. Many of the settlers were returnees from California's mother lode country, who continued to pursue prospecting for gold on the eastern slopes of the mountains. The trading post itself was operated by Mormons from Salt Lake City, but while Utah had ostensible political control over the region, no governmental authority was in fact exerted. Brigham Young, Territorial Governor of Utah, was simply too busy organizing territorial government in the more densely populated core of Mormon Utah, much closer to home.

The resultant benign neglect spawned a series of attempts by occupants of Utah's westernmost section to set up their own government, to be annexed by California, and finally, to become a territory separate from Mormon Utah. Despite late (1855) attempts to assert territorial authority in these western valleys, and the extension of Utah's county boundaries to include the region, the attempts at separate government were finally successful in 1961, when Congress authorized the establishment of the Territory of Nevada. In 1864, for political reasons, President Abraham Lincoln supported the rush to statehood and the State of Nevada was created. A large population was attracted to Nevada by the Comstock finds, a silver rush of unparralleled proportions in be North American continent. The silver of the Comstock caused a stampede comparable to the Gold Rush to California 10 years earlier. The "Rush to Washoe," as it was called, lasted for nearly 20 years, with some booms and busts throughout the entire period.

The southern tip of today's Nevada remained in New Mexico Territory until the Territory of Arizona was carved out of it in 1863. Prior to that date, a settlement had been attempted by Mormons at Las Vegas with a mission established to provide a way station for travellers between Salt Lake and San Bernardino, to raise cotton, and to pacify the Indians and teach them hygiene and agriculture. This settlement was occupied by Mormons only a short time. By 1858, all had left the region, and the adobe fort was abandoned briefly. It was reoccupied by non-Mormon miners and ranchers beginning in 1861, and has never been abandoned since. Throughout the entire 19th century, the story of Las Vegas Valley is essentially the story of ranching with the mining communities nearby dependent on the produce of these ranches for their foodstoffus. In 1867, all of Arizona north of the Colorado River was added to the state of Nevada by Congressional action, and the state achieved the configuration it has today.

Nevada's story is in extreme contrast to Utah's. Nevada has grown primarily through a series of boom and bust cycles that were tied to the fortunes of hard rock mining. Nevada's mineral wealth attracted thousands of people, but the difficulty in extracting the ores, in processing them and most importantly in getting them to market made Nevada a state attractive to the middle and upper income classes. A poor man could expect only to work in the mines, not to own them, unless he was the original discoverer. As the historic record reveals, most prospectors did not make the big strike, and those that did, sold out early and too low. Very few discoverers of significant ore bodies ever realized much profit from their finds (Lord, 1883, rep. 1959; G.H. Smith, 1943).

Agriculture and stock raising had early beginnings in Nevada, but the climate, poor soils and desert vegetation did not lend themselves to promotion of the individual family farm of 160 acres. Water is and always has been a critical determinant of the success of any activity in the Great Basin. Mining communities, ranching, and farming all sought the same resources. The relative fortunes often depended on the availability of water or lack of it, as much as on the quality of the ores, grasses, and markets. Without water, there could be no activity at all. Nevada water law quickly assumed extraordinary importance in this land of little rain. Under Nevada law, it is possible to own water rights without owning the land--of which 86 percent was retained by the federal government as a condition of statehood in 1864. The state retained the right to dispose of water rights, and the peculiar Nevada law reflects a situation in which the two basic, related resources were controlled by two differenct governmental entities.

A major consequence of this series of series of related factors was that while the Nevada homestead might be 160 acres, in conformity to federal or state law setting out the size permitted to one individual, in fact stock grazing was carried out over much larger parcels which were primarily in federal hands. The rancher need only file on the water rights to the springs and creeks on that land for him to control vast acreages. Generations of ranchers utilized the public lands in this manner, without control or competition, until the beginnings of federal controls in the early 20th century, made still more stringent in 1934 with the passage of the Taylor Grazing Act, and with the establishment of the U.S. Bureau of Land Management in 1946.

Development of both mine and farmlands was retarded in Nevada until the building of the railroad in the northern part of the state. When this line was finished in 1869, many mining booms were experienced in areas that had been too remote from markets, and cattle-sheep raising was encouraged by the availability of cheap transportation to markets for wool and hides. Northern Nevada benefitted greatly from this economic boom, while southern Nevada was restricted in the growth of stock raising and in mining activites because there was no railroad passing through the region until 1905. Mining and ranching on the perimeter of the area was stimulated by nearby rail lines, such as the extension of rails to southern Utah in the late 1880s and across the Mojave Desert to Needles in 1883. The vast interior of Nevada, however, remained undeveloped until the building of the San Pedro, Las Angeles and Salt Lake line in 1905, the construction of the Tonopah and Tidewater, the Las Vegas and Tonopah, and the Bullfrog and Rhyolite, all in 1906-1907. Agriculture was never as successful in the southern part of Nevada except in very well watered valleys such as the Oasis Valley, Muddy River, Pahranagat, Meadow Valley Wash, and Spring Valley. Cattle were permitted to roam an open range but the forage was not plentiful, and without major markets, there was no stimulus to develop the large acreages typical of northern Nevada ranches. Sheep were raised briefly by one of the northern Nevada outfits, Kaiser Land and Livestock, but proved unprofitable and sheep raising in southern Nevada was largely abandoned by 1911.

Nevada's economy, closely tied to the extremely limited water supply and the natural resources of a very arid region, permitted limited growth over a long period of time. People attracted to the region generally expected to remain but a short time, hoped to strike it rich in the meanwhile and then move on to more attractive climates, or triumphantly return home. This transient mentality characterized much of Nevada's population during boom times, while hard times were endured by the small resident population. Prior to the opening of the 20th century boom at Tonopah, Nevada's population had shrunk so low that there was debate in Congress about unmaking the state and dividing the land among neighboring states.

Several historical events of the 20th century spurred signficant growth of southern Nevada's population. The Bureau of Reclamation built its first major public works project in Central Nevada. Lahontan Dam was an arid lands reclamation project which provided additional irrigable land for farms in the hitherto dry central Nevada region. This type of project did not provide a signficant spur to growth, however, and Nevada went on much as before despite the dam. More important in terms of population growth and the state's wealth was the Boulder Canyon project of 1928. Congress authorized the Bureau of Reclamation to construct what was then the largest dam in the world to provide for several regional needs; flood control of the Colorado River, irrigation of the Colorado Desert of California, and water and power for the burgeoning metropolis of Los Angeles. The timing of this project was accidently just right for southern Nevada to benefit from the hugh injection of federal funds at a time when private funds were drying up and the nation was plunged into a deep depression. So, Nevada's population doubled in the decade of th 1930s, in large part because of the influx of workers for the dam construction, engineering of the water and power supply facilities, and the operation of the dam and National Recreation Area it created.

When the nation went to war in 1941, southern Nevada in particular was in a unique position to benefit demographically and economically. Lake Mead, the name given to the large pool of water behind the dam, was the largest man-made body of water in the world. It was tapped for its industrial potential at the start of WW II by the construciton of the Basic Magnesium Inc. (BMI) plant and a townsite built just for its workers. Magnesium is made from ores that require huge quantities of water in processing. The ores were found in central Nevada, but the water was available only in Lake Mead. An enormous project was conceived to mine the ores and ship them to southern Nevada, first in a roundabout way by rail, and then by truck on a new highway system built just for the purpose. The Basic Townsite, later named Henderson, tapped the Nevada water allocation from Lake Mead, and when the town was occupied in 1943 and opened its first school, and school district was immediately the 4th largest in Nevada, with 1,000 children (Sadovich 1974). A major demographic change resulted from migration to southern Nevada of southern blacks, lured by the promise of work at BMI. This influx has created a pocket of black population in Clark County unequalled anywhere else in the state.

Other direct impacts of WW II on Nevada included the development of the Las Vegas Aerial Gunnery School, which utilized the unpopulated desert lands of southern Nevada for training of pilots and gunners in aerial warfare. In the 1950s, this base became Nellis Air Force Base, home of the F-111 and a major traning operation for pilots and crews of highly sophisticated jet aircraft. During the decade of the 1940s, Clark County's population doubled again as a result of these activities.

The opening of the Nevada Test Site in the early 1950s caused increased activity in Las Vegas and its satellite communities, and at Nellis Air Base. A new population moved into Las Vegas, bringing with it demands for community services that were not available in the still young city. This population was highly educated, expected to continue its pursuit of higher education and to be able to educate its children in the community, and demand services such as community concerts, museums, and other cultural facilities which were lacking in southern Nevada, although of long standing in the better developed older northern communities. Resulting from these pressures was a college campus that now is larger in population than the Reno campus, two community college campuses, and a branch of the research institute of the university system. Southern Nevada's population tripled between 1950 and 1960, growing from ca. 16,000 to 45,000. This rate of growth continues in southern Nevada, which has water available for growth (at least until 1990), while growth is at a lesser rate in the northern metropolitan centers of Reno, Sparks, and Carson City. The 1980 census places 65 percent of Nevada's population in Clark County.

These booms have provided a steadily increasing population base for the state. The military reserves have been as transient at the mining communities, despite their susceptibility to the whim of Congress and Pentagon decisionmakers.

Tourism, however, is the mainstay of the state's economy. Prompted by fears of economic decline, Nevada in 1931 passed two pieces of state legislation that were intended to keep the then-poor state in competition with other states for a share of the growing divorce action. The six weeks residency law for divorce was passed in the spring of 1931 so that hotels and dude ranches would continue to be full of out-of-state residents who wished to shed their mates with a minimum of time. The tourism economy that was developing around the divorce business naturally expanded to provide entertainment and diversions for the new "residents," and gaming was conceived as one new way to increase the appeal of Nevada. This combination, while slow to grow in the depression of 30s, has proven hard to equal let along beat, and Nevada is the divorce (and marriage) capital of the U.S., with an eocnomy that depends still in large measure on the diversions offered to new residents for their duration in Nevada.

Gaming was slow to achieve the dominant position it now has in Nevada's economy. First the depression, then WW II slowed the construction of casinos and the traffic in them. Now, however, despite occasional slow periods, gaming and tourism are the number one sources of revenue for this land-poor water-hungry state. Although not totally recession proof, Nevada's economy has continued to thrive with this seemingly unsubstantial basis. Major entertainment has grown apace with the gaming industry, first as a lure to draw patrons into the casinos, and now as action in its own right. The industry is dependent upon non-residents for its support, and Nevada's economy is directly tied to the fortunes of California.

a. Agricultural. Nevada's agricultural settlement pattern is in strong contrast to the early Utah pattern. Nevada was settled by independent ranchers whose holdings were isolated from one another and often were based at considerable distance from any community. This pattern of settlement is very typical of American homesteading in the west, and the landscape this practice creates is quite different from that of the community patterning of Utah. It also is a practice that makes it difficult to locate and identify all of the agricultural settlements, since some were very ephemeral. It is a considerable problem to identify "home ranches," which were the headquarters of large grazing outfits which had "line camps" and temporary sites used during round-ups, branding and marketing of stock.

The only exceptions to the Nevada rule are the communities founded during the 19th century by Mormons from Utah. Panaca, Spring, and Eagle valleys and the Muddy River communities represent departures from the more typical Nevada Great Basin ranch. Many of these Mormons communities failed (Rosenvall, 1978), but a few have persisted, where the community served a wider regional market and adapted to the pressures of change. Panaca is an example of such a community.

Nevada's agricultural settlements will have to be treated on an individual basis, having developed independently though time.

b. Commercial. Commercial centers sprang up in Nevada beginning with the establishment of the first trading post at Mormon Station in 1850. Wherever traffic warrented it, an independent entrepreneur was attracted to provide services, and other settlers were in turn attracted to establish near these posts. Posts located at junctions of major routes of travel, or near mining operations, could expend their services to perform a variety of functions that would enable the store owner to withstand economic setbacks. Communities that expanded to serve a variety of economic niches were more viable than single-purpose towns, and therefore some modern towns developed out of humble beginnings. Few centers have reached any size, and some which were sizable in the past have shrunk. County seats that were established in towns that boomed because of mining have persisted into the modern period because of their governmental aspects, and continue to provide a variety of services for a large marketing region which might have a small population. Eureka, Pioche, and until recently Austin (which just lost its county seat status to Battle Mountain) all fall within this category.

Nevada's only river port in the 19th century (aside from Callville, which had a life span of only three years) was at El Dorado Canyon in southern Clark County.

This settlement functioned as an important commercial communty until 1910, when river steamboat traffic dieed out. The site is today buried under the waters of Lake Mohave, one of the reservoirs on the Colorado River.

Railroad towns became important commercial centers in Nevada. The Central Pacific Railroad built and named many of the town in northern Nevada; Elko is the largest of these towns today, and serves a marketing region that includes southern Idaho and northwestern Utah. In southern Nevada, Las Vegas was created by the railroad in 1905 out of the major ranch in the valley. Caliente was an important division point that declined drastically in size when the railroad switched from steam to diesel locomotives. The town persisted because of its important commercial role and its location on the main north-south highway through eastern Nevada.

c. Mining. Mining has been one of the most important activities in the development of Nevada. Since mining is exploitive, communities based only on mining tend to have very direct relationships to the fortunes of the mines. Even if the ores are not exhausted in the mines, if world demand for the mineral declines or the price is too high for American mining to compete with foreign producers, mines and their dependent communities close down. There are many documented instances of the immediate impact felt on one mining community brought about by the opening up of another, "boom" mine. Entire cities have disappeared from the Nevada landscape as a result of these processes: Hamilton, Treasure City, Schellbourne. Others have declined dramatically: Pioche, Goldfield, Tonopah, Belmont, Manhattan, Round Mountain. These communities are richly documented in the records, and an accurate assessment of their importance is relatively easily reached.

d. Military. Military sites of the 19th century consist of various army posts of varying duration. Nineteenth century sites are not as well documented as might be expected, and the exact localities of some sites have been obscured by more recent developments. Few bases were established in the area of Nevada that is expected to be impacted by M-X. Fort Ruby, on the eastern slopes of the Ruby Mountains, Fort Schellbourne in the Shell Creek Range, and minor temporary camps used by Lt. George Wheeler in his surveys of Nevada constituted the 19th century military sites. In southern Nevada, Camp Eldorado was established in the late 1860s, garrisoned by men from Camp Drum in San Pedro, California. These posts were temporary and no permanent establishment was made. Small detachments were stationed briefly at Las Vegas (1867) and Callville (1867).

In the twentieth century, military bases and depots of various kinds have become much more important. Much of the federally administered public land in Nevada has been removed for military purposes: Nellis Air Base, Nevada Test Site, Hawthorne Ammunition Dump. There are obvious historic values represented by these uses, but the sites are in current use and will not be directly involved in the M-X deployment. The reserves incorporated both historic and then active mining camps. These have been effectively removed from consideration of M-X impact since they are within the boundaries of military installations.

e. Political Capitals. The territorial capital of Nevada was Carson City; it is the state cpaital now. County seats sometimes have moved with the fortunes of the region. Nye County, for example, has had three county seats: Ione, Belmont, and now Tonopah. In some instances, a new county was carved out of a larger, previous county in order to serve a new booming area. Esmeralda County was carved out of Mineral County, and Goldfield was named the county seat at the opening of the twentieth century. As Goldfield's mines declined, so did the fortunes of the entire county, although there is still activity in Goldfield because of its county seat status.

Nevada also lost a county seat in 1867 when Arizona lost the portion of Pah-Ute County north of the Colorado to the State of Nevada. The triangle of land given to Nevada was composed mostly of land later designated Clark County. The county seat of Pah-Ute County, Arizona was Callville. Callville lost its claim to power when the area was transferred to Nevada. A ghost town after 1867, the site is now covered by the waters of Lake Mead.

HISTORIC PROPERTIES (2.3.2)

Known Types Of Cultural Resources From The Historic Period (2.3.2.1)

A useful typology of historic period sites has been developed by the BLM for its California Desert Project in the Mohave Desert. These site types are generally applicable within the present study area, with some additional site types added and site distinctions made which are appropriate to the Great Basin.

For purposes of this section, historic sites are defined as loci of past activity or activities of Hispanic and Euroamerican populations. It includes sites documented in the historic record (i.e., diaries, historic accounts, and other historic documents) and sites for which no written record or reference can be found. The historic period in the study area dates back to 1776. At the other end, a site is normally considered "historic" if it is 40 years or older. However, more recent sites that have maintained historical integrity (e.g., homesteads) or are associated with a significant event or activity (e.g., WW II training camps) may also be included.

The following site types can be placed into five cultural categories which are indicative of general activities:

(1) Exploration: Exploration involves historical sites associated with early expenditions, explorations, immigrations, and government surveys.

- o Exploration Route - Routes taken by early expeditions, explorers, travelers, and survey parties. Also included are routes used for domestic livestock drives. Associated campsites included.

(2) Settlement: Settlement includes those sites indicative of living activities and maintenance activities associated with settlement.

- o Town - A compactly settled area usually larger than a hamlet.
- o Hamlet - A small settlement.
- o Mining Camp - A settlement associated specifically with mining activities. This is also indicative of much more transient use than either town or hamlet.
- o Homestead - A tract of land acquired from U.S. public lands by filing a record and living on and cultivating the tract.

- <u>Farm</u> - A plot of land devoted to the raising of crops.

- <u>Ranch</u> - A plot of land devoted to the raising of beef cattle and/or other lifestock.

- <u>Post Office</u> - A building and/or site once officially designated as a local branch of the U.S. Post Office.

- <u>School</u> - A building used for educational instruction.

- <u>Structure</u> - Something that is constructed (e.g., building) of rock, adobe, wood, or a combination of these materals or other materials.

- <u>Dug Out</u> - A shelter dug in a hillside or dug in the ground and roofed with sod or earth.

- <u>Cemetery</u> - A place with historic human interments associated with Euroamerican activities (i.e., a historic burial ground).

- <u>Trash Dump</u> - A place where refuse or other discarded materials are accumulated or dumped.

- <u>Well</u> - A deep hole or shaft sunk into the earth to tap an underground supply of water.

- <u>Camp</u> - A camp used seasonally for tending livestock, e.g. sheep camp.

- <u>Ranching Related Features</u> - Corrals, pastures, fencelines, waterworks, reservoirs, etc.

(3) Military: Military encompassed remnants of past military activities.

- <u>Fort</u> - An official U.S. military designation for a permanent army post that is occupied continuously by troops.

- <u>Camp (1800s)</u> - The lowest official U.S. military designation for any army post that is usually small but has a permanent detachment of men assigned to it.

- <u>Camp (WW II)</u> - An official military post consisting mostly of tent structures and established as a base of operation for World War II training manuevers.

- <u>Outpost</u> - An unofficial military designation used in the 1860s to identify a temporary post to which a small detachment of men (usually a non-commissioned officer and 3-10 enlisted men) from a regional camp were temporarily assigned.

- <u>Redoubt</u> - A small, usually temporary, enclosed defensive work.

(4) Mining: Mining is a category to cover activities specifically related to the extraction and processing of locatable, salable, and/or hard rock minerals.

- o <u>Mine</u> - A pit or excavation in the earth from which mineral substances are taken.

- o <u>Shaft</u> - A vertical or inclined opening of uniform and limited cross section made for finding or mining ore.

- o <u>Adit</u> - A horizontal opening of uniform and limited cross section made for finding or mining ore.

- o <u>Tunnel</u> - A horizontal passageway through a ridge, hill, or mountain and associated with mining activities.

- o <u>Arrastre</u> - A device built to grind gold-bearing quartz. The early types consisted of a low stone and dirt wall built around a large and fairly level stone, hardpan, or flat rock-lined floor.

  A long horizontal beam was pivoted on a vertical post in the arrastre's center. One end of the beam was harnessed to a burro or mule to provide necessary power by walking in a circle outside the low arrastre wall. A heavy chain was fastened to the beam about midway, and the free end of the chain linked to a ring bolt wedged in a heavy drag stone(s).

- o <u>Ore Mill</u> - A site where crushing machinery, usually steam engine powered, was used to pulverize ore-heating rock to facilitate the extraction of gold and/or other metals. Five- and ten-stamp mills were most common.

- o <u>Mining Works</u> - An area where mining and/or processing works (e.g. flumes, chutes, sorters, etc.) are present.

- o <u>Charcoal Processing</u> - A site where wood is reduced to charcoal used in ore smelting. Beehive ovens are common features.

(5) Transportation/Communication: Sites that were involved with public conveyance of passengers and/or goods, especially for a commercial enterprise, and sites involved with conveyance of information.

- o <u>Pack Trail</u> - Historic foot and pack animal (horse and mule) route of travel that was not used by wagons.

- o <u>Wagon Road</u> - Route habitually used by wagons pulled by draft animals.

- o <u>Stage Route</u> - Trail utilized regularly by the stagecoach companies for handling passengers and mail.

- o <u>Stage Station</u> - Station used regularly by stage coaches, couriers for the purposes of changing horses or draft animals and loading and unloading passengers and freight.

- o Railroad - The remains of a permanent road having a line or rails fixed to ties and laid on a roadbed or berm and providing tracks for railroad cars.

- o Railroad Station - The building, remains, and/or regularly scheduled stopping place of the train for the purpose of loading and unloading passengers and freight.

- o Railroad Water Stop - A place along a railroad right-of-way where trains periodically stopped to take on water.

- o Telegraph/Telephone Line - The wire system used to transmit coded or verbal information.

- o Automobile Road (Early) - Road used for early automobile travel (e.g., Model-T, etc.).

(6) Other: Any site that is not defined by one of the above categories.

- o Isolated Find - Singular occurrence of a historic artifact such as the following: Bottle, Stirrup, Horseshoe, Tin Can, Wire, Cartridge, Tool, Farm Implement, etc.

Locations of Potential and Known Historic Sites (2.3.2.2)

A distinction is made here between potential historic site locations and known historic sites documented in site files. The previous tendency to not record historic properties for inclusion in state and agency site files has rendered these files inadequate for the purpose of documenting the nature and distribution of historic sites within the study area. To supplement the existing data on known sites, archival research is ongoing in order to document the existence of additional potential historic properties. Published and unpublished literature is being consulted in addition to maps and as many primary sources as possible including journals and diaries. County and church records have not been consulted as yet. To date, about 1,100 potential properties or locations have been identified (Tables 2.3.2.2-1 and 2.3.2.2-2) which conform generally to the site type categories outlined above (Section 2.3.2.1). The first phase of archival research is nearly complete for Nevada, but only partially complete for Utah. Known historic buildings, transportation routes, and railroads are provided in Appendix C by state and county where appropriate. A site file of these 100 potential site locations is being compiled.

Phase II studies will involve continued archival research of historic properties, and field verification studies to determine whether these properties still, in fact, exist and then to document site condition, integrity, and the scientific and cultural significance of the property for National Register eligibility.

2.4 REGIONAL SAMPLE SURVEY

During June-August, 1980, a regional sample survey program was implemented in the Nevada/Utah study area. A total of 813 sample units of 80 acres each were intensively surveyed in 31 hydrologic subunits. Selection of the study area for this survey was done prior to final selection of the DDA for the proposed action.

Table 2.3.2.2-1. Summary of Nevada historic and architectural properties by county.

COUNTY	TOWNS	MINES/MILLS/OTHER FEATURES	CHARCOAL PROCESSING	MINING CAMPS/ CAMPSITES	REFUSE DUMPS	CEMETERIES	BUILDINGS	HISTORIC NATIVE AMERICAN SETTLE-MENTS/RESERVATIONS	MORMON INDIAN MISSIONS/FARMS	MORMON TOWNS	MORMON FORTS	RANCHES	HOMESTEADS/FARMS/ CABINS	RANCHING-RELATED SITES	U.S. MILITARY FORTS/ CAMPS	CURRENT U.S. MILITARY RESERVES	RAILROAD TOWNS/ SIDINGS/CAMPS	RAILROAD-RELATED FEATURES	RAILROAD BEDS	PONY EXPRESS ROUTE/ STATIONS	OVERLAND MAIL ROUTE/ STATIONS	OTHER STAGE STATIONS/ ROUTES	TELEGRAPH LINES/ STATIONS	SHEEP CAMPS	DUGOUTS	OTHER	TOTAL
Churchill	3															1	1			2	7		1				15
Clark	10	5	1	4		1	5	4		10	2	5	2	5	1		9	2				1				12	79
Elko	10		1	1			1	2		1		13		3	2	1	8	4				1				8	56
Esmeralda	13	20		13		1									1		9					1					58
Eureka	7	2		4								1	1				12	8		3	1					5	44
Humboldt	2	1												2												1	6
Lander	32	4		7				1				1					14	1		5	4					1	70
Lincoln	14	17	3	18	2	2		1		16		60	5	5		1	25	1	2			9				12	193
Lyon	1											1			1		2			2							7
Mineral	6			2				1									3									1	13
Nye	24	13	5	53	4		1	12				4	14	2	1		13					16		1		4	167
Pershing	4											1					1										6
Storey	1													1			1										3
Washoe	1																1										2
White Pine	18	11	1	29	2	1		1		4		72	3	1	2		2	2		10	2	10		2		13	186
Total	146	73	11	131	8	5	7	22		31	2	158	25	19	8	3	101	18	2	22	14	38	1	3		57	905

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Table 2.3.2.2-2. Summary of Utah historic and architectural properties by county.

COUNTY	TOWNS	MINES/MILLS/OTHER FEATURES	CHARCOAL PROCESSING	MINING CAMPS/ CAMPSITES	REFUSE DUMPS	CEMETERIES	BUILDINGS	HISTORIC NATIVE AMERICAN SETTLE-MENTS/RESERVATIONS	MORMON INDIAN MISSIONS/FARMS	MORMON TOWNS	MORMON FORTS	RANCHES	HOMESTEADS/FARMS/ CABINS	RANCHING-RELATED SITES	U.S. MILITARY FORTS/ CAMPS	CURRENT U.S. MILITARY RESERVES	RAILROAD TOWNS/ SIDINGS/CAMPS	RAILROAD-RELATED FEATURES	RAILROAD BEDS	PONY EXPRESS ROUTE/ STATIONS	OVERLAND MAIL ROUTE/ STATIONS	OTHER STAGE STATIONS/ ROUTES	TELEGRAPH LINES/ STATIONS	SHEEP CAMPS	DUGOUTS	OTHER	TOTAL
Beaver	3							1		9		1			1		1									1	17
Box Elder																	4										4
Garfield										1																	1
Grande									1	1																	2
Iron	1									11	1						2					2					17
Juab	9	1		1						5					1		4			4	1						26
Millard	3								1	20	2				1		5	1				1				3	37
Salt Lake															1	1				3							5
Tooele	14		1		1			1	3	10		1			3		1			7	2		1			1	46
Utah	4									6	2				1					2							15
Washington	1								1	32				2												3	39
Total	35	1	1	1	1			2	6	95	5	2		2	8	1	17	1		16	3	3	1			8	209

4039

Therefore, not all hydrologic subunits within the current DDA have been studied (see Figure 2.2.4.1-1). Of the valleys studied, only Smith Creek (134) and Ione (135) do not contain DDA facilities. However, all hydrologic subunits studied are in the potential indirect impact area of the project.

The sampling design that guided the field program was developed by HDR Sciences. Additional inputs to the design were provided by the Nevada and Utah BLM archaeologists, the Nevada and Utah State Historic Preservation Officers, and subcontractors Woodward-Clyde Consultants, Inc. and Commonwealth Associates, Inc.

REGIONAL SAMPLING DESIGN (2.4.1)

To facilitate the gathering of comparable data from the large area under study, a multi-stage sampling design has been developed that is sensitive to local variability and is applicable over the entire study area. The sampling strategy is outlined here.

The general goal and objective of the sampling program is to provide data allowing for assessment of: (1) the relative significance and importance of valleys with respect to cultural resources; and (2) the impact on cultural resources when specific localities are selected as potential locations for M-X project facilities. Assessment of the relative significance of valleys with regard to cultural resources is made from existing survey data and relevant data that are obtained from the 1980 survey. The sampling program is, therefore, designed primarily for the second objective: assessment of impact on cultural resources by construction of M-X project facilities at designated valley locations.

The sampling program is divided into at least two stages of comparable size. Only Stage I sampling is involved in the 1980 survey. The Stage I sample consists of intensive survey of approximately 100 mi^2 (260 km^2). This was the amount of ground coverage that could be reasonably achieved in the first year of fieldwork given existing logistical and temporal constraints. Moreover, this is a very manageable and useful sample size for analytical purposes.

Both stages of the sampling program consider the division of the study area into separate valleys (hydrologic basins) as a given stratification criterion. Each valley is considered a subpopulation for sampling and statistical purposes.

For Stage I each valley is divided into Mountain and Alluvial Valley strata. Because the likelihood of direct impacts to cultural resources is substantially higher for the Alluvial Valley stratum, all sampling is conducted within that stratum during Stage I. The Alluvial Valley stratum is defined to include the foothill zone which is transitional between the two major sampling strata. Further stratification of the Alluvial Valley stratum is accomplished by distinguishing areas with relatively greater expected likelihood of site cluster location (Stratum A) and Other Valley (Stratum B). Stratum A is defined on the assumption that areas of site location are largely a function of resource location. Furthermore, subdivision of Stratum A is based on the assumption that the areal dispersion of resources has a major effect in shaping the spatial distribution of archaeological deposits that resulted from exploitation of those resources.

Resource distribution patterns are distinguished by point, line, and area. The first refers to resources such as springs, quarries, etc., which are essentially point sources in comparison to the scale of the site cluster. The second refers to resources associated with rivers, edges of lake beds, etc. The third refers to resources that are distributed in two dimensions, such as plant resources in open areas.

For point resources we expect a centrally oriented distribution of sites with highest density near the point resource and site density decreasing as one goes away from the resource. For lineal resources we expect a linear oriented distribution of sites with density contours roughly parallel to the distribution of resources. For areal resources we expect a two-dimensional patterning that may be affected in detail and configuration by the "grainedness" of the resource distribution.

For Stage I sampling, point resources are sampled at the location of the resource; for lineal resources, sample units are placed at an even distance along, and to the degree possible, perpendicular to the lineal distribution of the resource; the areal resources, sample units are placed in a systematic, unaligned fashion.

For purposes of operational definition, the following distinction and criteria are utilized for Stage I sampling:

Stratum A

Springs: Springs are considered point resources.

Playas: Playa boundaries are considered as lineal resources.

Permanent Streams:

a. The point of entry of a permanent stream into the valley is considered a point resource.

b. Permanent streams running the length of a valley are considered lineal resources.

Stratum B:

Other Valley: An area of the valley not included in Stratum A is considered an areal resource and sampled as a single, undifferentiated stratum. Sampling is by systematic, unaligned sampling. Sections are systematically selected and sample unit location sections are by random selection. Sample units are tied into the cadastral system. The area associated with Other Valley constitutes Stratum B.

For Stage I sampling, resource areas for which prior information indicates site cluster association are excluded from field survey. For example, springs known to have sites in association are not resurveyed in Stage I sampling.

Flexibility is integrated into this sampling design in two ways. First, crew chiefs are authorized to alter the locations of sample units in Stratum B within a four square mile area if it is discovered in the field that the originally selected unit is highly disturbed or is close to (but not on) a lacustrine feature. Second, ten percent of all of the sample unit locations are determined according to the discretion of the field personnel. This allows immediate testing of hypotheses developed in the field about areas where sites are likely to be located.

Sample units used for the field survey are described below:

- Oriented along the cardinal directions (i.e., either north-south or east-west). Rationale: for purposes of navigational simplicity and to take maximum advantage of the Township and Range system in areas where it has been surveyed.

- Oriented either north-south or east-west so as to maximize environmental variability (or changes in elevation) within sample units. Rationale: Stage 1 is oriented toward the discovery of potential site clusters. Maximizing environmental variability within sample units should raise the likelihood of discovering cultural resources particularly if those resources are differentially disturbed along an elevational or other environmental gradient.

- Inventoried and recorded so as to ensure maximum standardization of measurement and comparability of data. Standard sample unit and site record forms are adopted for use by all field subcontractors. All other field procedures are replicated to the maximum extent possible. Records of sample unit crew composition and other potential sources of systematic variability in measurement (e.g., weather conditions and time of day) are maintained so that analytical controls for such variability may be applied.

PRELIMINARY RESULTS (2.4.2)

Data from the first phase of survey are currently being encoded and no analysis of these data has yet been performed by HDR Sciences. Preliminary reports have been completed by Commonwealth Associates and Woodward-Clyde Consultants who were responsible for conducting the field surveys. Due to time constraints only minimal use was made of the results of the Phase 1 field data in the preparation of this technical report and in conducting impact assessments for the Draft EIS. These results will be incorporated into the Final EIS. Table 2.4.2-1 summarizes the results of the Phase 1 survey for the 31 hydrologic subunits that were studied. Based on these results it can be estimated that the Phase 1 study region of approximately 10,000 mi^2 would contain about 100,000 archaeological and historical sites. As was noted above, the study area for Phase 1 was similar in area to the Nevada/Utah DDA, but it did not include all DDA valleys. However this rough estimate is expected to be applicable to the Nevada/Utah DDA because any valleys not included are environmentally similar to the Phase 1 study valleys.

2.5 IMPACT ASSESSMENT

IMPACT SIGNIFICANCE (2.5.1)

For the purposes of the present analysis, all archaeological and historical sites which together comprise the cultural resource base in a region, are considered a significant resource.

Table 2.4.2-1. Preliminary results of phase 1 of an archaeological and historical regional sample survey in Nevada/Utah.

HYDROLOGIC SUBUNIT NO.	HYDROLOGIC SUBUNIT NAME	AREA SURVEYED (MI^2)	NUMBER OF SAMPLE UNITS	PREHISTORIC SITES	PREHISTORIC ISOLATES	HISTORIC SITES	HISTORIC ISOLATES
4	Snake	3.25	26	2	3	0	0
5	Pine	4.5	36	20	18	2	0
6	White	5.63	45	16	26	1	4
7	Fish Springs	2.88	23	17	18	1	5
8	Dugway	1.38	11	7	3	3	0
46	Sevier Desert	4.38	35	22	16	3	1
46A	Sevier Dry Lake	5.63	47	10	24	1	7
54	Wah Wah	3.25	26	4	10	0	4
134	Smith Creek	3.0	24	30	21	3	0
135	Ione	2.13	17	10	4	2	0
137A	Big Smoky—South	7.75	62	27	40	15	11
139	Kobeh	4.25	34	15	15	0	2
140A	Monitor—North	1.88	15	3	5	0	0
141	Ralston	2.13	17	7	9	3	4
151	Antelope	1.63	13	4	6	2	2
154	Newark	5.0	40	13	16	4	1
155A&B	Little Smoky—North	2.75	22	21	17	4	0
155C	Little Smoky—South	3.25	26	13	20	1	0
171	Coal	2.75	22	9	18	1	0
172	Garden	2.28	18	5	11	0	3
173B	Railroad—North	2.0	16	9	2	0	1
174	Jakes	2.13	17	14	10	0	0
175	Long	3.25	26	14	15	0	1
178B	Butte—South	2.63	21	10	8	3	1
179	Steptoe	1.38	11	4	0	0	0
180	Cave	1.75	14	18	15	0	1
181	Dry Lake	5.0	40	24	32	4	4
182	Delamar	2.63	21	4	13	1	3
183	Lake	5.13	41	40	28	3	2
184	Spring	3.25	26	13	15	0	0
196	Hamblin	2.5	20	6	9	0	0
	Totals	101.5	812	411	447	57	57

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Cultural resources are defined to include archaeological and historical districts, sites, structures, and objects and other evidence of human use considered to be of significant value to a culture, a subculture, or a community for scientific, traditional, religious, and other reasons. Increased recognition of these properties as nonrenewable resources has led to the enactment of federal legislation which mandates: (1) determination of potential effects of an undertaking on resources; and (2) preservation of sites in place or the preservation of data.

The concept of cultural resource significance is central to the legal process designed to ensure the preservation of cultural resources. Consequently, specific criteria for evaluationg cultural resource eligibility for inclusion on the National Register of Historic Places have been defined in federal regulations, 36 CFR 60.6.

To meet these criteria, the cultural resources "must arguably have at least a potential role to play in maintaining the integrity of a community or neighborhood, in the maintenance of some groups' sense of place and cultural value, or in the enhancement of human knowledge" (King and others, 1977:96). In practice, cultural resources are generally evaluated in terms of 1) the research value of the property and 2) the cultural value of the property to those groups associated with it. Therefore, two kinds of significance--cultural significance and scientific significance--are considered in the present evaluation. It has been assumed for this preliminary assessment of impacts that all cultural resources have potential scientific significance.

Furthermore, because these cultural resources are considered to be nonrenewable and because their destruction constitutes an irretrievable commitment of resources, project implementation will result in significant impacts to this resource base, if proper mitigation measures are not taken.

IMPACT ASSESSMENT METHODS (2.5.2)

To provide a summary assessment of impacts to cultural resources, data on archaeological, historical, and architectural resources have been analyzed in the following manner.

First, data from over 3,000 known cultural resources from 77 hydrologic subunits have been classified into four major types of sites: "multiple activity" which includes habitation sites; "special activity" sites exemplified by rock art, cemeteries, shrines, battlegrounds; "limited activity" sites which include small lithic scatters, refuse dumps, corrals, trails, short-term camps; and "isolated artifacts" which include any isolated artifact of human manufacture or use. Multiple activity, special purpose, and limited activity sites are generally considered eligible for inclusion on the National Register. Isolated remains, when considered in a regional context, have the potential to answer scientific questions.

The next stage in the analysis involved use of the locational characteristics of these known cultural resources to develop preliminary sensitivity rankings that were applied to the potential deployment valleys (Table 2.5.2-1). "Very high" sensitivity is reserved for those properties currently listed on the National Register of Historic Places. Existing data suggest that there is a high correlation between sites and water sources, therefore, "high" sensitivity is defined as a prescribed area around both present and extinct water sources. "Moderate" sensitivity is defined as

CONSEQUENCES WHICH ARE SPECIFIC TO AN INDIVIDUAL ENVIRONMENTAL VARIABLE

1. To what extent will the effect alter the carrying capacity of the environment for the resource?

1	2	3	4	5
no change in carrying capacity		some reduction in carrying capacity		major reduction in carrying capacity

Not applicable.

2. What is the effect of the disturbance on the integrity of the resource?

1	2	3	4	5
no change in integrity		some decrease in integrity		major decrease in integrity

Integrity of information contained in the undistributed archaeological or historical site is the first consideration in the determination of the scientific significance of a property. Dis ruption of the depositional history and <u>in situ</u> placement of artifact assemblages through surface or ground disturbance reduces significantly the capacity for a site "to yield information important in prehistory or history."

3. What is the effect of the disturbance on the quality of the resource?

1	2	3	4	5
no loss in quality		some loss in quality		major loss in quality

Resource quality must relate again to resource significance. The scientific quality of a property is significantly reduced when disturbed. Similarly, if a property is significant in terms of its value to a group, its quality or intrinsic cultural significance will also be diminished. Any undertaking that has an impact on cultural resources sufficient to affect site eligibility to the National Register is considered to have an adverse effect.

4. To what extent will the effect be masked by normal variation expressed by the resource?

1	2	3	4	5
completely masked		some masking		no masking

Not applicable.

5. To what extent will the effect on the resource be masked by normal resource variability when the influence of potential future projects other than M-X are imposed.

1	2	3	4	5
completely masked		some masking		no masking

Not applicable.

6. How rapidly will the resource recover from the disturbance effect if the effect is temporary?

1	2	3	4	5
rapid recovery		slow recovery		no recovery

Cultural resources are considered nonrenewable resources; therefore, no recovery is possible once disturbed.

7. How rapidly will the resource recover from the disturbance effect if the effect is permanent?

1	2	3	4	5
rapid recovery		slow recovery		no recovery

No recovery is possible once disturbed.

8. To what extent will the resource recover from the disturbance effect in a reasonable time period?

1	2	3	4	5
full recovery		moderate recovery		no recovery

No recovery is possible once disturbed.

9. To what extent will the resource recover from the effect when this effect is combined with other disturbances expected from M-X (cumulative effects)?

1	2	3	4	5
full recovery		moderate recovery		no recovery

No recovery is possible once disturbed.

10. How geographically widespread is the effect of the disturbance on the resource?

1	2	3	4	5
localized effect				widespread effect

Due to the large spatial requirements of M-X and the nature of site distribution, large numbers of particular classes of sites will be impacted. Not only will individual properties be disturbed, but the entire Great Basin cultural resource data base will be disrupted so that accurate reconstructions of past activities will be precluded.

11. To what extent will the effect change the aesthetic value of the resource?

1	2	3	4	5
no change in aesthetic value		moderate decrease in aesthetic value		major decrease in aesthetic value

Destruction or alteration of all or part of a property can be considered a major decrease in aesthetic value. Adverse effects also include isolation from or alteration of the property's surrounding environment and introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.

12. What is the scientific or intrinsic value of the resource?

1	2	3	4	5
low scientific or intrinsic value		moderate scientific or intrinsic value		high scientific or intrinsic value

The scientific value of a site or historic property rests on "the information contained in spatial associations among its constituent parts: (King 1977:97). Cultural resources may be said to be of high scientific or intrinsic value, if one of the following criteria is met:

(a) [association] with events that have made a significant contribution to the broad patterns of our history; or

(b) [association] with the lives of persons significant in our past; or

(c) [embodiment of] the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) [history of yielding, or potential] to yield information important in prehistory or history [36 CFR 60.6].

ISSUE I
COMPETITION FOR RESOURCES

1. How does a change in the effect affect the integrity of the resource?

1 2 3 4 5

Change in effect (ground disturbance) through site avoidance and protection can preserve site integrity; however, any increase in effect or other activities which do not consider site avoidance will have a proportionate decrease in resource integrity. This is especially true when the entire regional resource base is considered.

2. To what extent will the resource continue to be usable with the same level of quality?

1 2 3 4 5

no reduction in usefulness to humans	partial reduction in usefulness to humans	major reduction in usefulness to humans

Due to the large land requirements of M-X, large numbers of particular classes of sites will be impacted. This loss of part of the resource base cannot be adequately mitigated in the relatively short time prior to construction. Data recovery methods currently available do not allow the full recovery of the data potential of a site, and site destruction now precludes data recovery in the future.

3. What is the extent to which the resource will become limited to the point threatening the carrying capacity of the area or developmental trends which have already been in motion for some historic period of time.

1 2 3 4 5

Not applicable.

1 2 3 4 5

ISSUE 2

CONSTRAINT ON FUTURE DEVELOPMENT OPPORTUNITIES

1. Is the change in the effect observable relative to the potential variations in the baseline or trust or other competitors for these development opportunities.

1 2 3 4 5

Not applicable.

2. To what extent does the change in the effect produce a developmental constraint that is observable?

1 2 3 4 5

Not applicable.

3. To what extent does the change in the effect variable degrade the environmental resource which is or would be needed by other competitors?

1	2	3	4	5
no constraint on other future uses		moderate constraint on other future uses		major constraint on other future uses

Because sites are nonrenewable, destruction of an historic property, whether through land development or data recovery efforts, precludes its future use for scientific inquiry and removes it as a symbol of cultural identification.

4. To what extent does the change in the environmental variable when combined with competing opportunities cause a considerable stress on some portion of the environment which would not occur if the competition were not there or if constraints were imposed on the developmental directions for the various interested competitors.

1	2	3	4	5

Not applicable.

5. To what extent is the change in the effect variable a significant modifier of other developmental actions which are planned to take place. For example, will it compete for the same space, will it cause that space to be unusable, will it require stress on limited resources, changes in transportation of goods, etc.?

1 2 3 4 5

Not applicable.

1 2 3 4 5

ISSUE 3
STRESS ON GROWING COMMUNITIES

1. Is the change in the effect variable large or the same value as established standards for this particular effect?

1 2 3 4 5

Not applicable.

2. Is there a reasonable opportunity for recovery from changes in this effect in a reasonable period of time?

1 2 3 4 5

Community planning resulting from community studies and inventories of architectural and historical properties and design guidelines for future development would have to be implemented in order to allow for mitigation of growth related impacts. If this does not occur there will be no opportunity for recovery.

3. Will the quality of the area necessarily have to be changed in order to accommodate the changes in these effects?

1 2 3 4 5

Because many of the small communities in the study area have not undergone significant growth, the architectural character and integrity of these communities are well preserved. Rapid growth without consideration of these qualities will result in the demolition of significant structures and disruption of community character, thereby adversely affecting the quality of the community.

4. Will the change in these effects levels produce a permanent change in some sector of the environmental and if so will that change be in total contrast with other induced changes already in process for the future development of the area or will these permanent changes be in concert with other expected changes?

1 2 3 4 5

(See 3.)

5. Will the change in the effect level be significant within the context of the uncertainties of the growth pattern of the impacted regions? That is, if one assumes a 10 percent potential fluctuation in either the compositional structure of the demographics or in the absolute value of the population growth will the changes due to M-X be significantly larger or approximately the same amount of much smaller than this 10 percent absolute change?

1 2 3 4 5

Not applicable.

6. Will growth trends in the area in terms of sectoral composition, population density, urban-rural transitions, and other uses of the land be modified significantly by M-X or will M-X's changes fit within the predicted trends for these areas?

1 2 3 4 5

Growth trends of 100%+ caused by M-X in some areas does not fit within the predicted trends for these areas. The character and composition of some rural communities will be modified significantly.

7. Will planning for these areas require significant funding specifically for the properties and requirements of M-X or can they be included in umbrella types of funding which would include the future plans of the area and those requirements of M-X which add stress to the growing communities?

1 2 3 4 5

Because most rural Nevada/Utah communities have not experienced large scale growth, few communities have community plans, building codes, and design guidelines to accommodate the growth expected to result from M-X. Preservation of architectural and historical properties and community character through rehabilitation, restoration, and construction guidelines has not been considered adequately in the past. New funding and community participation would be required.

8. Will M-X require significant additional short-range planning or planning significantly accelerated relative to the planning required for the future development of the area?

1 2 3 4 5

Inventories, community planning, and research into the architectural history of a community should be underway in those communities where growth is expected to be substantial.

9. To what extent will funding be required to mitigate the effect on the resource?

1	2	3	4	5
no funding required to mitigate		moderate funding required to mitigate		major funding required to mitigate

Inventories, planning, restoration, rehabilitation.

10. To what extent will the effect on the resource have significant economic or social consequences on communities within the study area?

1	2	3	4	5
no significant economic or social consequences				major significant economic or social consequences

Not applicable.

ISSUE 4
PRESERVATION OF BIOPHYSICAL AND CULTURAL RESOURCES

1. What is the legal status of the resources?

1	2	3	4	5
no legal status	state protected (game and nongame)	state protected rare or endangered	proposed federally protected	federally protected (threatened and endangered)

Cultural resources are protected by a number of federal and state laws. Principal federal laws include:

- National Historic Preservation Act (1966)
- Archaeological Resources Protection Act (1979)
- Archaeological and Historic Preservation Act (1974)
- Executive Order 11593
- National Environmental Policy Act
- Federal Regulations 36CFR800, and others

These laws mandate (1) avoidance or preservation of the cultural resource in situ, or (2) when avoidance is not possible, preservation of the data that might irretrievably be lost as a result of site destruction due to project implementation.

2. Will the effect potentially indirectly affect those resources which are legally protected?

1	2	3	4	5
minimal likelihood of affecting a legally protected resource		moderate likelihood of affecting a legally protected resource		high likelihood of affecting a legally protected resource

Indirect impacts are likely to be substantial and are certain to affect significant cultural resources. These impacts will result from two major factors: (1) induced population growth, and (2) increased accessibility. Reducing population incursion and access would serve to reduce these indirect impacts.

3. Will the effect require either behavioral modifications or changes in life patterns in order to preserve the specific cultural resources?

1 2 3 4 5

Not applicable.

4. Will the effect lead to a permanent degradation of some portion of the ecosystem which the cultural resources depends on?

1 2 3 4 5

Not applicable.

5. Will the effect lead to a degradation of some portion of the ecosystem which contains resources needed for the preservation of a cultural or biological resource?

1 2 3 4 5

Not applicable.

6. Will the effect cause a degradation in the quality or aesthetics of the particular resource that is to be preserved, and will this be a major or a minor change in the aesthetic or quality feature?

1	2	3	4	5
no degradation of quality or aesthetics		moderate degradation of quality or aesthetics		major degradation of quality or aesthetics

The scientific quality of a property is significantly reduced when disturbed. Vandalism of historic properties will significantly impact the aesthetic quality of standing structures. Any undertaking that has an impact on cultural resources sufficient to affect site eligibility to the National Register is considered to have an adverse effect.

GENERAL CONSEQUENCES

1. Are the consequences such that the portion of the cultural resource base or society will not recover at all?

1	2	3	4	5
no likelihood of irreparable damage		moderate likelihood		certain irreparable damage to the resource base

Due to the large scale land requirements of M-X, large numbers of particular classes of sites will be impacted. This loss of portions of the regional resource base cannot be adequately mitigated, especially considering the relatively short time prior to construction. Moreover, data recovery methods currently available do not allow the recovery of the full data potential of a site. Site destruction now precludes data recovery in the future. Not only will individual properties be destroyed, but the entire Great Basin resource base will be disrupted so that accurate reconstructions of past lifeways will be precluded.

2. Are the consequences such that the impact may be large, but the recovery processes will overcome the damage in a reasonable period of time?

1	2	3	4	5
full recovery		partial recovery		no recovery

Cultural resources do not recover.

3. Are the deleterious effects measurable?

Direct Impacts

1	2	3	4	4.5	5
not measurable		measurable with difficulty			readily measurable

Indirect

1 1.5 2 3 4 5

4. Will the effect change the functional relationships existing within the archaeological and historical record, and will this cause a change in the viability associated with the system?

1	2	3	4	5
no change in functional relationships		moderate change in relationships		major change in relationships

(See 1.) Reconstructions of past lifeways will be made extremely difficult if not precluded altogether.

5. Do these deleterious effects or consequences result in degradation of other measurable environmental variables?

1 2 3 4 5

Not applicable.

6. Although the environmental effect itself may not be significant within the framework of the first five criteria, will it when measured in conjunction with certain other critical environmental variables produce changes that are observable within the framework of the criteria of the five standards?

1 2 3 4 5

Not applicable.

Table 2.5.2-1. Archaeological and historical sensitivity descriptions for the Nevada/Utah study area.

SENSITIVITY DESCRIPTION	DEFINITIONAL CRITERIA
Very high	National Register sites (2-mi radius) or districts (1-mi buffer zone)
High	*Springs:* Valley springs - a radius of 1 mi (1.6 km) Playa margins - a 1-mi (1.6 km) wide zone around the perimeter Perennial streams: (a) a 1-mi (1.6 km) zone along each side of streams flowing through valleys (b) a 1-mi (1.6 km) radius around the point where permanent mountain streams enter a valley Known site clusters
Moderate	Unwatered foothills - a zone 2 mi (3.2 km) wide at the juncture between mountains and valley alluvium The area between 1-2 mi (1.6-3.2 km) from springs
Low	Unwatered mountain areas Playa bottoms Unwatered Mid-lower bajada areas
Very low	Not used. Further research may show that certain highly disturbed areas have very low sensitivity

800-1

unwatered foothills and applies to the outer 1-2 mi from springs. Here, site density is likely to be somewhat less than areas within 1 mi of water sources, but generally greater than the valley as a whole. Again, existing single data suggest that there is a tendency for site density to decrease as the distance from a spring increases. The foothill zone, too, is expected to have generally higher site density than the valley as a whole due to the greater occurrence of exploitable resources. "Low" sensitivity is reserved for steep, unwatered mountain areas, playa bottoms, and unwatered mid-to-lower bajada areas. Again, existing site data suggest that these areas have the lowest site density.

The preliminary results from an intensive sample survey that included 813 80-acre sample units in 31 hydrologic subunits are briefly considered. The sampling design developed for this survey defined two sampling strata. Stratum A included locations immediately adjacent to permanent water resources (e.g. springs, streams) and the margin of playas. Stratum B included all other portions of the hydrologic subunits except the mountains, which were not sampled in this first phase. Thus, Stratum A included all areas here defined as high sensitivity. Stratum B included primarily the low sensitivity zone, though the moderate sensitivity zone is included here as well. Further analysis should provide additional information about the moderate sensitivity zone, but this zone was only minimally sampled in this first phase of survey. The differential density and distribution of archaeological and historic resources in these sampling strata provides support for the utility of the sensitivity zones used in this analysis (Table 2.5.2-2). Further refinements in these sensitivity zones should be possible as analysis continues.

In order to assess the potential impacts to cultural resources from the Proposed Action, the amount of area for each sensitivity level was calculated for each valley from maps indicating both known and predicted areas of sensitivity. The proposed system was then overlaid, and direct impacts to each sensitivity level were estimated based on the set of assumptions for construction area requirements indicated in Table 2.5.2-3. The areas shown in this table differ from the land disturbance figures generated by the construction model in two ways. First, it was assumed that 10 acres would be disturbed around each shelter, rather than 2.5 acres. Second, disturbance along road rights of way were assumed to be 200 ft rather than 100 ft. The reasons for these larger figures are as follows. First, it is expected that during construction there will be unplanned disturbance outside of the official rights of way. Second, while construction is underway, workers are likely to discover cultural resources that are in close proximity to the right of way. In many cases, unauthorized collection or other damage to those resources is likely to result. Third, overtime use of project roads by the general public is likely to result in greater disturbance along road rights of way due especially to ORV use. While all of the above are technically indirect impacts, it was judged most efficient to consider them under the direct impact category. This is because they occur in such close proximity to direct impact areas and because the likelihood of their eventually occurring is so high. Because areas required for certain M-X facilities have not been mapped, approximately 15 mi^2 of direct construction impacts cannot be evaluated at this time; however, it is likely that these impacts will be dispersed throughout the deployment area and not differ significantly from facilities shown on the conceptual layout.

Indirect impacts for the DDA are expected to result in the short-term as a result primarily of the presence or proximity of a construction camp within a

Table 2.5.2-2. Preliminary results of the Nevada/Utah regional sample survey that supports the sensitivity zones in the impact analysis.

SAMPLING STRATUM	SITE DENSITY ($SITES/MI^2$)	SAMPLE UNITS WITH SITES	SAMPLE UNITS WITH TWO OR MORE SITES
Stratum A (No. of units = 173)[a]	7.0	43.4%	18.1%
Stratum B (No. of units = 550)[b]	2.7 .	18.7%	5.6%

3865

[a]Both historic and prehistoric sites are considered in this table. Isolated remains have not been included.

[b]Only 793 sample units are included in this table. The other 90 sample units were placed according to different criteria by the field teams and have, therefore, been omitted from this table.

Table 2.5.2-3. M-X system facilities area requirements assumptions used for cultural resource analysis.

DESCRIPTION	FULL SYSTEM		SPLIT BASING[1]	
	Acres	mi^2	Acres	mi^2
DDA Facilities:				
Shelters[2]	46,000	71,9	23,000	35.9
Cluster roads	144,000	225.0	75,150	117.4
DTN	30,545	47.7	17,700	27.7
Support roads	32,000	50.0	16,000	25.0
Area Support Centers	165	0.3	110	0.2
Construction Camps	375	0.6	225	0.4
TOTAL	253,085	395.5	132,185	206.6
Facilities Not Considered[3]:				
CMF	1,040		520	
RSS	70		35	
Concrete Plants	500		500	
Material Source Points	150		90	
Wells	150		155	
Marshalling Yards	1,950		1,625	
Construction Roads	6,060		4,240	
TOTAL	9,920	15.5	7,165	11.2
OB Facilities:				
First OB	6,140	9.6	6,140	9.6
Second OB	4,240	6.6	6,140	9.6
DAA	1,950	3.1	3,900	6.1
OBTS	250	0.4	16,430	25.7
TOTAL	12,580	19.7	16,430	25.7
TOTALS	275,585	430.7	155,780	243.5

3677-1

[1]DDA area required for one region.

[2]Area includes antenna.

[3]Not included in analysis.

hydrologic subunit. Other factors that would affect the likelihood of indirect impacts are increased access, as provided by the construction of new roads for the M-X project, and the abundance of archaeological resources within a particular subunit. For assessing long-term indirect effects within the DDA, only increased access and local resource abundance were considered. White it is recognized that the major source of potential indirect impacts is the increased population that will be localized at OBs, those impacts are considered for each particular OB location.

In assessing overall impacts, a uniform method was used but it is recognized that there remains a significant subjective element. To a large degree this is a result of a limited data base. For example, estimates of the magnitude of direct effects are probably the most accurate, while estimation of indirect impacts remain imprecise. Scaling the significance of these effects is more problematic. For example, if scientific significance is considered, the magnitude of impacts probably increases exponentially with increased land disturbance. For properties with high cultural significance, however, any level of disturbance may result in unacceptably high impact levels. Therefore, it is recognized that these are preliminary impact assessments and an effort has been made to scale these evaluations consistently for this project. Because of the large magnitude of this project the scales employed here may not be appropriate for comparison with other smaller-scale projects.

In the sections that follow, four categories of cultural resources are considered separately. This provides the opportunity to provide some important details that are lost when all cultural resources are lumped together.

IMPACTS (2.5.3)

In the sections that follow, four categories of cultural resources are considered separately. This provides the opportunity to provide some important details that are lost when all cultural resources are lumped together.

National Register of Historic Places

A number of sites currently listed on the National Register of Historic Places could be directly or indirectly affected by project activities (Table 2.5.3-1). While the direct effects are probably avoidable, indirect impacts are likely to result from increased recreational activities, off-road vehicle use and vandalism.

Archaeological Resources

Both direct and indirect effects on archaeological resources are anticipated result of constructing the M-X project in Nevada/Utah.

Archaeological resources are nonrenewable, therefore their preservation in place is generally the most desirable management alternative. With advanced planning, preservation in place can be achieved to a significant degree by developing project layouts that avoid known and predicted high sensitivity areas to the maximum extent feasible. The ability to accurately predict areas of high sensitivity will increase as the data from the first phase of field investigation are analyzed and with the implementation of a second phase of regional survey. These results will be used in Tier 2 decision-making. Emphasis is placed on obtaining reliable predictive data in early project stages because of the limited locational flexibility once engineering layouts of clusters have been developed.

Table 2.5.3-1. Potential impacts to current and proposed National Register properties within the Nevada/Utah DDA.

TYPE OF IMPACT	VALLEY NUMBER AND NAME	NATIONAL REGISTER PROPERTY
Direct	46 Sevier Desert	42MD300 - Paleoindian archaeological site.
	175 Long Valley	Sunshine locality - archaeological district.
Indirect	7 Fish Springs	Fish Springs Cave - archaeological site.
	46 Sevier Desert	Fort Deseret - historic site. Topaz War Relocation Center - buildings. Gunnison Massacre Site
	140 Monitor	Belmont - historic mining town Gatecliffe Shelter - archaeological site
	156 Hot Creek	Tybo Charcoal Ovens
	181 Dry Lake	Bristol Wells - historic minign town.
	182 Delamar	Delamar - historic mining town.
	208 Pahroc	White River Narrows Archaeological District
	209 Pahranagat	Black Canyon Petroglyphs.
	210 Coyote Spring	Sheep Mountain Range District

3866

Positive scientific and educational effects are expected results of the cultural resources studies implemented as part of the M-X project. These studies will enrich scientific knowledge on aboriginal and historic lifeways within the Great Basin and special programs are being planned to communicate such results to the general public.

The current assessment of impacts is predictive, but prior to initiation of any construction activities, intensive surveys of areas of proposed land disturbance will be undertaken. All cultural resources encountered will be evaluated for eligibility to the National Register, and mitigation measures will be developed and implemented in consultation with the appropriate SHPOs and the Advisory Council on Historic Preservation. In those cases where data recovery programs are necessary, an irretreivable resource commitment is made. While data recovery methods are intended to efficiently record the maximum amount of information feasible, there is inevitably information lost. For example, the opportunity to apply more effective data recovery techniques developed in the future is lost with the implementation of a data recovery program. Additionally, not all cultural resources can be included in a data recovery program for a large project such as M-X. While sampling designs will help ensure that needed data are efficiently gathered during data recovery programs, even large samples will result in a significant irretrievable commitment of cultural resources. Furthermore, because of the large spatial extent of the M-X project and its large area of potential surface disturbance, it is possible that large numbers of particular types of archaeological resources may be impacted. For example, sites consisting of surface scatters of chipped stone artifacts are very common in Great Basin valleys and large numbers of these sites may be directly impacted by this project. Similarly petroglyph sites, rock shelters, and ghost towns are site types that will be subjected to high rates of indirect impacts. Loss of very large numbers of particular classes of sites over a relatively short time simply cannot be adequately mitigated by data recovery programs, and it is recognized as a probable irretrievable resource commitment that would result from implementation of the M-X project.

Historical Resources

Both direct and indirect effects to historical resources can be expected from construction of the M-X system in Nevada/Utah. Because most direct impacts will occur in valley settings, historical resources most likely to be affected include ranches and homesteads, abandoned settlements, features and structures associated with ranching, farming, mining, or transportation networks such as railroads and trails. For example, the Pony Express/Overland Stage route crosscuts the potential deployment area and a number of the stations as well as portions of the route itself are potentially impacted by project deployment. Five stations occur in DDA valleys in Nevada, while eight stations are in DDA valleys in Utah. The early Dominguez-Escalante trail which follows the eastern boundary of the study area may also be subject to direct impacts.

Currently about 850 historic period sites have been identified in those counties that contain DDA (Table 2.5.3-2). Analysis of those and other data suggest that potential highly sensitive locations for historic resources include areas near springs, wells, along permanent streams, and in the mountain foothills.

In addition, the first phase regional sample survey of 100 mi^2 is designed to record any historic properties encountered in valley and foothill settings with select

Table 2.5.3-2. Frequencies of known historic sites by county that are subject to potential direct and indirect impacts.

COUNTY	TOWNS	MINES, MILLS, MINING CAMPS	CHARCOAL PROCESSING	CEMETERIES	BUILDINGS	MORMON MISSIONS, FARMS, TOWNS, FORTS	RANCHES, HOMESTEADS, FARMS	U.S. MILITARY SITES	RAILROAD-RELATED SITES	PONY EXPRESS, OVERLAND MAIL, STAGE ROUTES	TOTAL
Nevada											
Clark	10	9	1	1	5	12	7	1	9	1	56
Esmeralda	13	33	0	1	0	0	0	1	9	1	58
Eureka	7	6	0	0	0	0	2	0	12	4	31
Lander	32	11	0	0	0	0	1	0	14	9	67
Lincoln	14	35	3	2	0	16	65	1	25	9	170
Nye	24	66	5	0	1	0	18	1	13	16	144
White Pine	18	40	1	1	0	4	75	2	2	22	165
Utah											
Beaver	3	0	0	0	0	9	1	1	1	0	15
Iron	1	0	0	0	0	12	0	0	2	2	17
Juab	9	2	0	0	0	5	0	1	4	5	26
Millard	3	0	0	0	0	23	0	1	5	1	33
Tooele	14	0	1	0	0	13	1	3	1	9	42
Washington	1	0	0	0	0	33	0	0	0	0	34
Total	149	202	11	5	6	127	170	12	97	79	858

3750

[1]Towns and some of the other historic site types listed above frequently consist of multiple historic properties.

sample units placed in the mountains. Mountain areas will be more fully addressed in subsequent phases of the sample survey when areas of potential direct and indirect effects are better defined. Historic data from the sample surveys will be used for planning purposes to avoid significant properties. In addition, intensive preconstruction surveys will be conducted in proposed construction areas.

The greatest potential indirect impacts properties will be as a result of the substantial increase in local population in construction areas and in the vicinity of operating bases. Because of the highly visible nature of many historic sites such as ghost towns, mining camps, homesteads, and other standing structures, these properties will become the focus of vandalism, relic and bottle hunting, and robbing of materials. Furthermore, while access to many of these properties is already reasonably good, the project road system will provide increased access to these sites.

The PMOA commits the USAF to a coordinated program of studies which, when implemented, will serve to avoid or satisfactorily mitigate adverse effects on historic properties.

Architectural Resources

Induced population and community growth could have indirect effects on architectural resources. Communities such as Ely, Tonopah, Caliente, Pioche, and Eureka in Nevada, and Delta, Milford, Beaver, and Fillmore in Utah, that are in close proximity to DDA valleys are those where the potential for affecting architectural resources is highest.

IMPACT LEVELS (2.5.4)

Using the impact assessment methods described in previous sections, a set of summary tables were prepared that show impacts of the Proposed Action, Alternatives 1-6, and Alternative 8 for each affected hydrologic subunit. Table 2.5.4-1 summarizes impacts of the DDA for all but Alternative 8, Table 2.5.4-2 summarizes impacts of the OBs for all alternatives, and DDA impacts of Alternative 8 are shown in Table 2.5.4-3. These assessments are based on predictions rather than on data from field surveys of potential direct and indirect input areas, thus they will have to be revised as better data become available in the future.

Table 2.5.4-1. Potential impacts to archaeological and historical resources in Nevada/Utah DDA for the Proposed Action and for Alternatives 1-6.

HYDROLOGIC SUBUNIT NO.	HYDROLOGIC SUBUNIT NAME	RELATIVE SENSITIVITY[1]	SHORT-TERM EFFECTS: DISTURBANCE OF ARCHAEOLOGICAL AND HISTORICAL SENSITIVITY AREAS (SQ MI) MODERATE TO HIGH	SHORT-TERM EFFECTS: DISTURBANCE OF ARCHAEOLOGICAL AND HISTORICAL SENSITIVITY AREAS (SQ MI) LOW	SHORT-TERM EFFECTS: POTENTIAL IMPACT[1]	LONG-TERM EFFECTS: POTENTIAL IMPACT[1]
Subunits with M-X Clusters and DTN						
4	Snake		5.8	23.8		
5	Pine		0.8	9.0		
6	White		2.0	10.6		
7	Fish Springs		0.8	6.0		
8	Dugway		0.6	6.4		
9	Government Creek		1.2	1.2		
46	Sevier Desert		2.8	17.4		
46A	Sevier Desert & Dry Lake[2]		1.5	8.4		
54	Wah Wah		4.5	11.1		
137A	Big Smoky-Tonopah Flat		1.3	8.0		
139	Kobeh		4.1	11.2		
140	Monitor N & S		4.5	7.1		
141	Ralston		3.8	13.2		
142	Alkali Spring		1.8	8.1		
148/9	Cactus Flat & Stone Cabin[2]		3.1	9.5		
151	Antelope		3.3	7.2		
154	Newark[2]		1.8	4.7		
155A	Little Smoky N & S		7.3	7.5		
156	Hot Creek		4.8	10.0		
170	Penoyer		1.4	10.5		
171	Coal		3.1	6.8		
172	Garden		1.7	7.5		
173A	Railroad N & S		5.9	23.9		
174	Jakes		2.9	4.6		
175	Long		2.0	3.4		
178B	Butte-South		1.8	7.0		
179	Steptoe		1.2	0.0		
180	Cave		0.9	5.0		
181	Dry Lake[2]		4.3	14.3		
182	Delamar		0.8	4.9		
183	Lake		2.3	7.0		
184	Spring		0.7	3.3		
196	Hamlin		4.3	8.2		
202	Patterson		0.4	1.5		
207	White River		3.3	10.7		
208	Pahroc		0.3	0.5		
209	Pahranagat		0.0	2.0		
	Overall DDA	High	93.1	301.5	High	High

3901

[1]

No impact.

Low impact.

Moderate impact (moderately sensitive).

Moderately high to high impact (high sensitivity).

[2]Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 1 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE[1]	PROPOSED ACTION COYOTE SPRING/MILFORD	
NO.	NAME		SHORT-TERM IMPACT[1]	LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High		
46A	Sevier Desert-Dry Lake[2]	High		
50	Milford[2]	High	High	High
52	Lund District	Low	Moderate	Moderate
53	Beryl-Enterprise	Low		
179	Steptoe	Moderate		
210	Coyote Spring	Moderate	High	High
219	Muddy River Springs	Moderate	High	High
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	High	High	High
5	Pine	High	Moderate	Moderate
6	White	High	Moderate	Moderate
46	Sevier Desert[2]	High	High	High
53	Beryl-Enterprise	Low	High	High
169	Tikaboo	Moderate	Moderate	Low
170	Penoyer	Moderate	Moderate	Low
180	Cave	High	Moderate	Low
182	Delamar	High	Moderate	Moderate
183	Lake	High	High	High
196	Hamlin	High	High	High
202	Patterson	High	High	High
205	Meadow Valley	High	High	High
206	Kane Springs	High	High	High
208	Pahroc	High	Moderate	Moderate
209	Pahranagat	High	Moderate	Moderate
	Overall Impact for OB	High	High	High

3902-2

[1] No impact. Low impact. Moderate impact. High impact.

[2]Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 2 of 8)

HYDROLOGIC SUBUNIT OR COUNTY NO.	HYDROLOGIC SUBUNIT OR COUNTY NAME	RELATIVE SENSITIVITY TO DISTURBANCE[1]	ALTERNATIVE 1 COYOTE SPRING/BERYL SHORT-TERM IMPACT[1]	ALTERNATIVE 1 COYOTE SPRING/BERYL LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High impact		
46A	Sevier Desert-Dry Lake*	High impact		
50	Milford [2]	High impact		
52	Lund District	Low impact	Moderate impact	Moderate impact
53	Beryl-Enterprise	Low impact	Moderate impact	Moderate impact
179	Steptoe	High impact		
210	Coyote Spring	High impact	High impact	High impact
219	Muddy River Springs	High impact	High impact	High impact
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	High impact	High impact	High impact
5	Pine	High impact	Moderate impact	Moderate impact
46	Sevier Desert[2]	High impact	Moderate impact	Moderate impact
53	Beryl-Enterprise	Low impact	High impact	High impact
169	Tikaboo	Moderate impact	Moderate impact	Moderate impact
170	Penoyer	Moderate impact	Moderate impact	Moderate impact
172	Garden	Moderate impact	Moderate impact	Moderate impact
180	Cave	High impact	High impact	High impact
182	Delamar	High impact	Moderate impact	Moderate impact
183	Lake	High impact	High impact	High impact
196	Hamlin	High impact	High impact	High impact
202	Patterson	High impact	High impact	High impact
205	Meadow Valley	High impact	High impact	High impact
206	Kane Springs	High impact	High impact	High impact
207	White River[2]	High impact	Moderate impact	Moderate impact
208	Pahroc	High impact	Moderate impact	Moderate impact
209	Pahranagat	High impact	High impact	High impact
	Overall Impact for OB	High impact	High impact	High impact

3902-2

[1] No impact. / Moderate impact. / Low impact. / High impact.

*Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 3 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE	ALTERNATIVE 2 COYOTE SPRING/DELTA	
NO.	NAME		SHORT-TERM IMPACT	LONG-TERM IMPACT
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High	High	High
46A	Sevier Desert-Dry Lake	High	High	High
[illegible]	Milford	High		
52	Lund District			
53	Beryl-Enterprise	Low		
[illegible]	Steptoe	High		
[illegible]	Coyote Spring	High	High	High
[illegible]	Muddy River Springs	High	High	High
	Curry County, NM			
	Hartley County, TX			
	Other Affected Subunits or Counties			
4	Snake	High	High	High
6	White	High	High	High
7	Fish Springs	High	Moderate	Moderate
9	Government Creek	Moderate	Moderate	Moderate
53	Beryl-Enterprise	Low	High	High
169	Tikaboo	Moderate	Moderate	Moderate
180	Cave	High	High	High
182	Delamar	High	Moderate	Moderate
183	Lake	High	Moderate	Moderate
184	Spring	High	Moderate	Moderate
196	Hamlin	High	High	High
202	Patterson	High	High	High
205	Meadow Valley	High	High	High
206	Kane Springs	High	High	High
208	Pahroc	High	Moderate	Moderate
209	Pahranagat	High	Moderate	Moderate
	Overall Impact for OB	High	High	High

3902-2

No impact. Moderate impact.

Low impact. High impact.

Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 4 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE[1]	ALTERNATIVE 3 BERYL/ELY	
NO.	NAME		SHORT-TERM IMPACT[1]	LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High impact.		
46A	Sevier Desert-Dry Lake[1]	High impact.		
50	Milford[2]	High impact.		
52	Lund District	Low impact.	Moderate impact.	Moderate impact.
55	Beryl-Enterprise	Low impact.	High impact.	High impact.
179	Steptoe	High impact.	High impact.	High impact.
210	Coyote Spring	High impact.		
219	Muddy River Springs	High impact.		
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	High impact.	High impact.	High impact.
5	Pine	High impact.	High impact.	High impact.
6	White	High impact.	High impact.	High impact.
46	Sevier Desert	High impact.	High impact.	High impact.
156	Hot Creek	High impact.	Moderate impact.	Moderate impact.
172	Garden	Moderate impact.	Moderate impact.	Moderate impact.
174	Jakes[1]	High impact.	High impact.	High impact.
180	Cave	High impact.	High impact.	High impact.
183	Lake	High impact.	High impact.	High impact.
184	Spring	High impact.	High impact.	High impact.
196	Hamlin	High impact.	High impact.	High impact.
202	Patterson	High impact.	High impact.	High impact.
205	Meadow Valley	High impact.	High impact.	High impact.
207	White River[2]	High impact.	High impact.	High impact.
	Overall Impact for OB	High impact.	High impact.	High impact.

3902-2

[1]

(open box)	No impact.	(vertical hatching)	Moderate impact.
(divided box)	Low impact.	(solid dark box)	High impact.

[2]Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 5 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE[1]	ALTERNATIVE 4 BERYL/COYOTE SPRING	
NO.	NAME		SHORT-TERM IMPACT[1]	LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High		
46A	Sevier Desert-Dry Lake[2]	High		
50	Milford[2]	High		
52	Lund District	Moderate	Moderate	Moderate
53	Beryl-Enterprise	Moderate	High	High
179	Steptoe	High		
210	Coyote Spring	High	High	High
219	Muddy River Springs	High	High	High
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	No	High	High
5	Pine	No	Moderate	Moderate
6	White	No	Moderate	Moderate
46	Sevier Desert	No	High	High
169	Tikaboo	Moderate	Moderate	Moderate
170	Penoyer	Moderate	Moderate	Moderate
172	Garden	Moderate	Moderate	Moderate
180	Cave	High	High	High
182	Delamar	High	Moderate	Moderate
183	Lake	High	High	High
184	Spring	High	Moderate	Moderate
196	Hamlin	High	High	High
202	Patterson	High	Moderate	Moderate
205	Meadow Valley	High	High	High
206	Kane Springs	High	High	High
207	White River[2]	High	Moderate	Moderate
209	Pahranagat	High	Moderate	Moderate
	Overall Impact for OB	High	High	High

3902-2

[1] No impact. Moderate impact. Low impact. High impact.

[2] Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 6 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE[1]	ALTERNATIVE 5 MILFORD/ELY	
NO.	NAME		SHORT-TERM IMPACT[1]	LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High impact.		
46A	Sevier Desert-Dry Lake[2]	High impact.		
50	Milford[2]	High impact.	Moderate impact.	Moderate impact.
52	Lund District	Low impact.	High impact.	High impact.
53	Beryl-Enterprise	Low impact.		
179	Steptoe	High impact.	High impact.	High impact.
210	Coyote Spring	High impact.		
219	Muddy River Springs	High impact.		
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	High impact.	High impact.	High impact.
5	Pine	High impact.	High impact.	High impact.
6	White	High impact.	High impact.	High impact.
46	Sevier Desert	High impact.	High impact.	High impact.
46A	Sevier Desert-Dry Lake[2]	High impact.	Moderate impact.	Moderate impact.
54	Wah Wah	Moderate impact.	Moderate impact.	Moderate impact.
156	Hot Creek	High impact.	Moderate impact.	Moderate impact.
172	Garden	High impact.	Moderate impact.	Moderate impact.
174	Jakes[2]	High impact.	High impact.	High impact.
180	Cave	High impact.	High impact.	High impact.
183	Lake	High impact.	High impact.	High impact.
184	Spring	High impact.	High impact.	High impact.
196	Hamlin	High impact.	High impact.	High impact.
202	Patterson	High impact.	High impact.	High impact.
207	White River[2]	High impact.	High impact.	High impact.
	Overall Impact for OB			

3902-2

[1] (blank box) No impact. (vertical-bar pattern) Moderate impact. (open grid pattern) Low impact. (dark pattern) High impact.

[2] Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 7 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY TO DISTURBANCE[1]	ALTERNATIVE 6 MILFORD/COYOTE SPRING	
NO.	NAME		SHORT-TERM IMPACT[1]	LONG-TERM IMPACT[1]
	Subunits or Counties within OB Suitability Area			
46	Sevier Desert	High impact.		
46A	Sevier Desert-Dry Lake[2]	High impact.		
50	Milford[2]	High impact.	Moderate impact.	Moderate impact.
52	Lund District	Low impact.	High impact.	High impact.
53	Beryl-Enterprise	Low impact.		
179	Steptoe	High impact.		
210	Coyote Spring	High impact.	High impact.	High impact.
219	Muddy River Springs	High impact.	High impact.	High impact.
	Curry County, NM			
	Hartley County, TX[2]			
	Other Affected Subunits or Counties			
4	Snake	High impact.	High impact.	High impact.
5	Pine	High impact.	Moderate impact.	Moderate impact.
6	White	High impact.	High impact.	High impact.
46	Sevier Desert	High impact.	High impact.	High impact.
53	Beryl-Enterprise	Low impact.	Moderate impact.	Moderate impact.
54	Wah Wah	Moderate impact.	Moderate impact.	Moderate impact.
180	Cave	High impact.	High impact.	High impact.
183	Lake	High impact.	High impact.	High impact.
184	Spring	High impact.	Moderate impact.	Moderate impact.
196	Hamlin	High impact.	High impact.	High impact.
202	Patterson	High impact.	Moderate impact.	Moderate impact.
205	Meadow Valley	High impact.	High impact.	High impact.
206	Kane Springs	High impact.	High impact.	High impact.
207	White River[2]	High impact.	Moderate impact.	Moderate impact.
209	Pahranagat	High impact.	Moderate impact.	Moderate impact.
	Overall Impact for OB	High impact.	High impact.	High impact.

3902-2

[1] No impact. Moderate impact. Low impact. High impact.

[2] Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-2. Potential impact to archaeological and historical resources from operating bases (OBs) for the Proposed Action and Alternatives 1-6 and 8. (Page 8 of 8)

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY[1]	ALTERNATIVE 8 COYOTE SPRING/CLOVIS			
			SHORT-TERM EFFECTS			LONG-TERM EFFECTS
			DISTURBANCE OF ARCHAEOLOGICAL AND HISTORICAL SENSITIVITY AREAS (SQ MI)		POTENTIAL IMPACT[1]	POTENTIAL IMPACT[1]
NO.	NAME		MODERATE TO HIGH	LOW		
	Subunits and Counties with OB Suitability Areas					
210	Coyote Spring		9.0	3.0		
219	Muddy River Springs		1.0	—		
	Curry, NM		13.1			
	Other Affected Subunits and Counties					
205	Meadow Valley		—	—		
206	Kane Springs		—	—		
209	Pahranagat		—	—		
	Bailey, TX		—	—		
	Castro, TX		—	—		
	Deaf Smith, TX		—	—		
	Lamb, TX		—	—		
	Parmer, TX		—	—		
	Chaves, NM		—	—		
	DeBaca, NM		—	—		
	Quay, NM		—	—		
	Roosevelt, NM[2]		—	—		
	Overall Impacts for OB		—	—		

3902-2

[1] No impact. Moderate impact.
Low impact. High impact.

[2] Conceptual location of Area Support Centers (ASCs).

Table 2.5.4-3. Potential impact to archaeological and historical resources in Nevada/Utah and Texas/New Mexico DDAs for Alternative 8.

HYDROLOGIC SUBUNIT OR COUNTY		RELATIVE SENSITIVITY[1]	SHORT-TERM EFFECTS			LONG-TERM EFFECTS
			DISTURBANCE OF ARCHAEOLOGICAL AND HISTORICAL SENSITIVITY AREAS (SQ MI)		POTENTIAL IMPACT[1]	POTENTIAL IMPACT[1]
NO.	NAME		MODERATE TO HIGH	LOW		
	Subunits or Counties with M-X Clusters and DTN					
4	Snake		1.8	11.3		
5	Pine		1.0	10.5		
6	White		0.8	1.4		
46	Sevier Desert		1.1	14.0		
46A	Sevier Desert-Dry Lake[2]		1.8	8.0		
54	Wah Wah		5.2	12.9		
155C	Little Smoky—Southern		2.1	3.0		
156	Hot Creek		5.6	10.1		
170	Penoyer		1.6	12.2		
171	Coal		3.6	7.9		
172	Garden		2.0	8.7		
173A	Railroad—Southern		3.0	15.6		
173B	Railroad—Northern		—	—		
180	Cave		1.1	5.8		
181	Dry Lake[2]		5.0	16.6		
182	Delamar		0.9	5.7		
183	Lake		2.7	6.2		
184	Spring		0.8	3.8		
196	Hamlin		5.0	9.5		
202	Patterson		0.5	1.8		
207	White River		3.0	12.4		
208	Pahroc		0.7	0.3		
	Bailey, TX		0.9	—		
	Cochran, TX		4.3	—		
	Dallam, TX		17.8	—		
	Deaf Smith, TX		18.0	—		
	Hartley, TX[2]		17.8	—		
	Hockley, TX		1.2	—		
	Lamb, TX		0.6	—		
	Oldham, TX		1.8	—		
	Chaves, NM		37.5	—		
	Curry, NM		3.6	—		
	DeBaca, NM		4.5	—		
	Harding, NM		16.2	—		
	Lea, NM		1.3	—		
	Quay, NM		23.5	—		
	Roosevelt, NM[2]		14.7	—		
	Union, NM		12.6	—		
	Other Affected Subunits or Counties					
	Castro, TX		—	—		
	Moore, TX		—	—		
	Potter/Randall, TX		—	—		
	Sherman, TX		—	—		
	Yoakum, TX		—	—		
	Guadalupe, NM		—	—		
	San Miguel, NM		—	—		
	Cimarron, OK		—	—		
	Overall DDAs		—	—		

3916-2

[1] No impact. Low impact. Moderate impact. High impact.

[2] Conceptual location of Area Support Centers (ASCs).

3.0 TEXAS/NEW MEXICO CULTURAL RESOURCES

This section reviews current information on Texas/New Mexico cultural resources following the same general outline employed in Section 2.0. General introductory material covered in Section 1.0 applies to both Nevada/Utah and Texas/New Mexico cultural resources, and is not repeated here.

3.1 NATIONAL REGISTER PROPERTIES

In the Texas/New Mexico study area, there is a wide variety of properties on the National Register of Historic Places. These properties are summarized in Tables 3.1-1 and 3.1-2. The importance of the National Register is discussed in Section 2.1.

There are two main categories of Register properties: historic and prehistoric. Prehistoric properties include archaeological sites and districts. Historic properties include, but are not limited to, buildings and historic districts.

Register properties are to be found in both rural and urban areas. Historic or architecturally significant buildings are likely to be found within city limits, such as the E. B. Black House in Deaf Smith County, Texas. Archaeological sites are more commonly found in less populated areas, as exemplified by the Rocky Dell and Landergin Mesa sites in Oldham County.

3.2 ARCHAEOLOGICAL RESOURCES

This section provides an overview of current knowledge regarding the nature and distribution of archaeological resources in the Texas/New Mexico study area. Specifically, previous research is reviewed, the regional culture history is summarized, and there is a discussion of current research problems.

PREVIOUS RESEARCH (3.2.1)

Previous research in Texas and New Mexico is considered separately. Research in the New Mexico portion of the study area has generally been sporadic. Up until the 1950s, almost no work was done in the area. Adjacent areas produced evidence of human association with the extinct bison at the Folsom site (Cook, 1927) and poorly documented material which appears to date to the Archaic period occurs along the Cimarron River (Renaud, 1930, 1937), both to the north of the study area. During this time, a far greater emphasis was put on the investigation of the Puebloan cultures to the west, sites from which exist close to the study area (Kidder, 1926; Lister, 1948), and the Panhandle Aspect along the Canadian and Cimarron Rivers, particularly in Texas (Holden, 1930; Krieger, 1946; Mera, 1944). Research on the Panhandle Aspect is discussed in greater detail below.

During these early investigations, two important sites were excavated in the study area, both of which are best known for their Paleoindian remains. The San Juan site on the edge of the northern escarpment of the Llano Estacado (Roberts, 1924) and the Blackwater Draw site south of Clovis (Hester, 1972, summarizes the work done from 1932 to 1963 at Blackwater Draw). Blackwater Draw, the type site for the Clovis Pleistocene mammals from its lower strata, as well as Archaic and Neoindian remains from higher levels. Similar remains were found at San Juan,

Table 3.1-1. National Register of Historic Places, Texas study area.

NAME	TYPE OF ENTRY	COUNTY
E. B. Black House	Building	Deaf Smith
Rocky Dell	Rock Art Site	Oldham
Landergin Mesa	Archaeological Site	Oldham
Bivens House	Building	Potter
Landergin-Harrington House	Building	Potter
McBride Ranch House	Building	Potter
Alibates Flint Quarries and Texas Panhandle	Archaeological District	Potters
Pueblo Culture National		
Monument		
L. T. Lester House	Building	Randall

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Table 3.1-2. New Mexico study area National Register of Historic Places.

NAME	TYPE OF ENTRY	COUNTY
Hondo Reservoir	Reservoir	Chaves
Archaeological Site AR 30-6-1047	Archaeological Site	Chaves
James Phelps White House	Building	Chaves
Fort Sumner Railroad Bridge	Object	De Baca
Fort Sumner Ruins	Buildings	De Baca
Baish Oil Well Number One	Object	Lea
Archaeological Site AR-30-630 and AR-7-73	Archaeological Site	Lea
Richardson Store	Building	Quay
Anderson Basin (Blackwater Draw)	Archaeological District	Roosevelt
Rabbit Ears (Clayton Complex)	Site	Union

814

although the oldest occupations such as those found at Blackwater Draw, are lacking at the San Juan site.

The 1950s added little to the sketchy knowledge accumulated earlier. The reputation of the South Plains as a center of Paleoindian research was strengthened by the synthesis of Sellards (1952) and Wormington (1957), discussing the Folsom, San Juan, and Blackwater Draw sites in addition to several more in adjacent areas of Texas. The excavation of the Milnesand Site (Sellards, 1955), a Paleoindian bison kill site in Roosevelt County, also added to this emphasis. The Blackwater Draw Site also yielded evidence of Archaic wells (Evans, 1951) during this period. Salvage excavations at the Pidgeon Cliffs site (Steen, 1955) documented occupation from the early Archaic period in the area north of Clayton; Gunnerson (1959) investigated Puebloan occupations near the study area; and Dick (1953) excavated two Neoindian rock shelters near Tucumcari.

By far the most important work of the 1950s in the study area was Jelinek's program of survey and excavation in the Middle Pecos Valley, carried out mainly from 1956 to 1960 as his dissertation research (Jelinek, 1960) and later published with additional data collected in 1965 (Jelinek 1967). This survey formed the basis for the first regional synthesis in the study area, and presents a basic chronology from the Paleoindian through the historic periods, with the greatest emphasis on the Puebloan occupation in the area. This work remains the basic reference for the Middle Pecos.

The 1960s opened with Wndorf's (1960) summary of the prehistory of the northern portion of the study area, in which he notes the paucity of work in the area. The sketchy knowledge of this region was also emphasized by Baker and Campbell (1960) who described sites and artifacts dating from the Paleoindian and Archaic periods from Union and Harding counties.

Several more systematic regional projects also date to the 1960s. One of the most important of these is the environmental and archaeological work on the Llano Estacado carried out by a large interdisciplinary team at the beginning of the decade (Wendorf and Hester, 1962, 1975). The ghrust of this project was the reconstruction of the Late Pleistocene environments of the Llano. This research represents a major step forward for the understanding of Paleoindian adaptations in the area.

The construction of Ute Dam also triggered a regional survey near the confluence of Ute Creek and the Canadian River (Hammack, 1965), which mainly documented the later (Neoindian and Historic) occupations of the area. To the south, a similar emphasis on later occupations is apparent in the work of the Lea County Archaeological Society, particularly at the Laguna Plata and merchant sites (Corley, 1965; Corley and Leslie, 1960; Leslie, 1965, 1968). The research of this group has documented the existence of small, permanent Puebloan villages east of the Pecos River, associated with ceramics which link them to the Jornada Mogollon culture to the west.

Several individual sites from the Paleoindian and Archaic periods were also reported from the area south of the Canadian River during this period. The Elida Site, a small Folsom campsite (Hester, 1962; Warnica, 1961) was found in Roosevelt County; to the south of it, the Rattlesnake Draw site (Smith, et al., 1966) produced

Paleoindian and later materials as well as the only Archaic wells known for the area outside of Blackwater Draw. Other investigations of Archaic sites were reported In Roosevelt (Warnica, 1965) and Curry counties, including excavations at Billy the Kid Cave (Kung, 1969). Studies outside of the study area but relevant to it include Campbell's (1969) work on the Apishapa Focus of the Colorado Plateau, which he considers to be the precursor of the Panhandle Aspect, and Gunnerson's (1969) work on historic aboriginal (Apache) occupation in the vicinity of Cimarron, both to the north of the area considered here.

The boom in contract archaeology in the 1970s has resulted in some increase of our knowledge of the study area, particularly of the later occupations, but it has not triggered any major projects. Two large surveys near the study area have been carried out in connection with the construction of Los Esteros (Henderson, 1974; Levine and Mobley, 1976; Mobley et al., 1978) and Brantley (Bousman, 1974; Gallagher, 1976; Henderson, 1976) Reservoirs. Both of these surveys mainly located sites from Puebloan and later periods, although limited amounts of material from earlier periods were also found. Smaller projects near the study area include Hurst's (1976) work near Maroon Cliffs where Archaic and later material was found, and a survey near Laguna Plata (Haskell, et al., 1977) which found similar remains in addition to quarry debris and included intensive reinvestigations of the Laguna Plata site. This site was earlier excavated by the Lea County Archaeological Society (Runyan, 1972; see above).

Work which is more directly relevant to the study area has concentrated on similar subjects. Thoms (1974) has published a general synthesis of the archaeology of the northern portion of this area, but other work has been very specific in scope. Paleoindian studies have been largely confined to reanalyses of existing data, including Broilo's (1971) analysis of projectile points and Hester and Grady's (1977) study of Llano Estacado social patterns. One radiocarbon date from Archaic deposits at Blackwater Draw has been reported (Brannon, et al., 1975), and Klausner and Johnson (1978) have reported on four lithic scatters which may also date to this period. Four other lithic scatters have been attributed to Puebloan occupation (Wiseman, 1978). Other later period sites reported include the Neff Site, a tool manufacturing and maintenance site dating from A.D. 1000 to 1200 (Wiseman, 1971), and petroglyph sites near Olive Butte (Schaafsman, 1972).

Single isolated Paleoindian and Archaic points along with 50 sites dating to the Periods after A.D. 700 were found in the Mescabera Plain by Clifton (1973). This survey also has the distinction of being the only survey carried out in the Texas/New Mexico study area which was based on exploit sampling strategy.

Texas

The Texas study area can be divided into northwestern and southwestern Panhandle portions. The following section on the northwestern Panhandle has been taken with slight modifications from Speer (1980: 42-53).

The first report on Texas Panhandle archaeology was by T. L. Eyerly of the Canadian Academy, Canadian, Texas (Eyerly 1907). It deals with excavations at a group of structures called the Buried City (Handley Ruin) located in Ochiltree County. As with most early studies, the data provided are very limited; however, Woodland cultural affiliations are suggested.

The first nationally known archaeologist to undertake systematic survey and test excavation in the Northwestern Panhandle was Dr. Warren K. Moorhead of Phillips Academy, Andover, Massachusetts. He commenced work in 1919, publishing his findings in a national periodical (Moorehead 1921), where he mentioned a lengthy report describing 70 sites, but provided no other details. In 1931, Moorehead reported results of another survey when excavations were done at the Alibates Ruins in Potter County; and Landergin Mesa and Rocky Dell (both National Register sites) were visited.

Beginning in 1929, Dr. W. C. Holden of Texas Tech University, Lubbock, surveyed, excavated, and reported on several village ruins in the region, including the Tierra Blanca Ruin in Deaf Smith County (Holden 1931). Here Holden tested one of several structures and features, presumed to be Antelope Creek Focus. He ultimately concluded otherwise, but did not attempt to identify the structure. Ruins at this site are currently being reinvestigated, with essentially the same results. Definition of this important site awaits analysis of the present study; however, it appears to be primarily an Apache site.

In 1930, J. A. Mason reported on the excavation of two structures located at Alibates Creek. In 1935, E. B. Sayles provided the first synthesis of Panhandle archaeology. This rare volume is unavailable for study; however, the Panhandle-Plains Historical Museum Reported Site records cite letter correspondence between Sayles and J. Hughes briefly describing three sites in Sherman County, three sites in Oldham County, four sites in Potter County, and five sites in Deaf Smith County.

In the early 1950s, Floyd V. Studer, a dedicated amateur who had grown up in Canada while Eyerly and Moorehead were working in the area and had been studying the archaeology since the early 1900s, began to report results of his many years of exploration in the stream valleys of the Canadian River where he had recorded 100 major ruins. There is a problem with the Studer data in that Studer was somewhat protective and perhaps deliberately misleading about the locations of many of these ruins. Mooreheads' 1931 volume includes a field map of Studer's that shows supposed locations of some sites, including 12 in Oldham County, nine in Potter County, two in Moore County, and one in Randall County. This map shows Landergin in Moore County, although it is actually some distance away in Oldham County. Whether this is by accident or design is not known. The Reported Site records at the Panhandle-Plains Historical Museum identify an additional five Studer sites in Oldham County, 29 in Potter County, two in Moore County, four in Randall County, and one in Deaf Smith County.

In 1934, Studer published findings on partial excavation of 11 of 24 structures at the Coetas Creek Ruin in Potter County, describing architecture, artifacts, and other site components.

In 1938, A. T. Jackson published the first comprehensive study of Texas Indian rock art. It includes photographs and descriptions of Rocky Dell and an unnamed site in Oldham County, one site in Potter County, and one site in Randall County.

By the middle to late 1930s, archaeologists were beginning to record the presence of a different prehistoric group than the Panhandle villagers, namely the Paleoindian big-game hunters. Among important excavated early man sites of the region are: Folsom (Cook 1927), Blackwater Locality No. 1 (Howard 1935); Miami

(Sellards 1938); Lipscomb (Barbour and Schults 1932); San Jon (Roberts 1942); Plainview (Sellards et al., 1947); Lubbock Lake (Sellards 1952); Domebo (Leonhardy 1966); Lake Theo (Harrison and Smith 1975); and Rex Rodgers (Willey, Harrison and Hughes 1978; Speer 1978).

In 1938, extensive excavations of two village ruins near the Canadian River were undertaken by Ele M. and Jewel A. Baker. The sites involved were the Alibates Ruins in Potter County, and the Antelope Creek Ruins in Hutchinson County, barely outside of the study area. With the aid of a Works Progress Administration crew, the Bakers excavated 52 rooms, five cysts, and 14 burials at Alibates Ruin 28; one room at Ruin 28A; and eight rooms at Ruin 30. They recovered thousands of artifacts and much architectural data, both at Alibates and at Antelope Creek, which had previously been excavated by C. Stuart Johnston (1939). The Antelope Creek Ruin later became the type locality for the Antelope Creek Focus of the Panhandle Aspect Village complexes. The final field report on the Baker project was completed in 1941, but has never been made available to the scientific community at large.

During World War II, the pace of archaeological investigations slowed in the Texas Panhandle, as elsewhere. Significant contributions of this time period include the early rock art studies of Forrest Kirkland (1942), which culminated in a comprehensive and beautiful volume published 25 years later (Kirkland and Newcomb 1967). In this book, Kirland provides descriptions of four sites in Oldham County, three in Potter County, and one in Randall County. Some of these sites had previously been reported by Jackson, although not in as much detail.

Another major study of the war era is Alex D. Krieger's Culture Complexes and Chronology in Northern Texas, wherein the Panhandle Aspect and Antelope Creek Focus are defined and an attempt is made to link the village ruins of the Canadian River Valley with other village cultures where cultural sequences are better known. Krieger evaluates the Alibates Ruins and Coetas Creek Ruins in this volume, and designates Alibates a component of the Antelope Creek Focus.

The 1950s saw the beginning of a long series of reports dealing with the Alibates flint quarry, which is the only National Monument in Texas. Some publications are: Bryan (1950); Shaeffer (1958); Green and Kelley (1960); Anthony (1963); Hertner (1963 and 1964); and Mewhinney (1965). None of these studies is definitive.

In 1952, Dr. Jack T. Hughes began his career as a Texas Panhandle archaeologist at the Panhandle-Plains Historical Museum in Canyon. He initiated a systematic survey and salvage program designed to examine all phases of Panhandle archaeology as thoroughly as possible, and has published numerous reports on the subject over the past 30 years. Among the most important of these may be those that deal with two near voids in the regional literature--the Archaic and early Neoindian cultural stages. Reports on the Archaie include: Hughes (1955, 1959, 1975, 1976); Tunnell and Hughes (1955); Hughes and Hood (1976); Etchieson, Speer and Hughes (1978 and 1979). Some dealing with early Neoindian sites are: Hughes (1959, 1962, 1969); Hughes and Willey (1978). His writings represent a synthesis of Panhandle archaeology, and none can afford to be overlooked. Many are cited elsewhere in this text.

During the 1950s and early 1960s, a number of comprehensive volumes containing information about Texas Panhandle archaeology were published. These include a survey of Oklahoma archaeology (Bell and Baerreis 1951), two reviews of Paleoindian occupation in North America (Sellards 1952; Wormington 1957), two handbooks of Texas archaeology (Suhm, Krieger and Jelks 1954; Suhm and Jelks 1962), two volumes of projectile point descriptions (Bell 1958 and 1960), a bibliography of Texas archaeology (Campbell 1960), and a synthesis of prehistoric man on the Great Plains (Wedel 1961).

By the early 1960s, attention had begun turning toward the archaeologically significant subject of the paleoenvironment of the region. Wendorf's 1961 pioneer study of the apleocology of the Llano Estacado was followed by a climatology study of the Southern Plains (Baerreis and Bryson 1965), another Southern Plains study (Wendorf and Hester 1975), and most recently a review of the paleoenvironment of Texas (Bryant and Shafer 1977). The paleoenvironment of the region remains poorly known, and studies are continuing at the present time. They frequently are included as parts of archaeological studies.

In the early 1960s, an event took place that has had a far-reaching effect on the archaeology of the region. This was the decision to dam the Canadian River in Hutchinston County to create a large reservoir (Sanford). The reservoir is located in the heart of one of the richest archaeological regions in the Texas Panhandle and is a major recreational facility in a water-deprived region. A systematic inventory was initiated. David (1962) appraised the area describing 28 sites in Potter County and five in Moore County. Green (1967) excavated three sites in Potter County and two in Moore County. Hughes conducted a preliminary reconnaissance, reidentifying four previously reported sites in Potter County, and recorded 13 others. He also cited nine sites in Moore County previously recorded by the NPS in a 1972 reconnaissance. Many of the sites described by these authors are Panhandle Aspect village ruins, but other kinds of sites such as camps, burials, and rock art sites from other cultural stages, also are reported.

Also in 1974, Hughes surveyed a small area of the Alibates National Monument, located in Potter County, recording one previously unreported site and one possible site. In 1975, Hughes and Taylor tested these sites, neither one of which is extensive. In 1974, Bousman assessed the resources of the National Monument and of the Lake Meredith Recreation Area. For the Monument area, he listed 54 previously recorded sites, classified as follows: 11 Panhandle Aspect; 34 workshop/quarry; one camp, two historic; two petroglyph; and four other sites. For the Recreation area, he listed: 81 Panhandle Aspect; 88 quarry workshop; five Archaic; 36 camp; two petroglyph; two midden; three rockshelter; nine gathering station; eight historic; and 41 other sites.

The National Park Service and Water and Power Resources Service both participate in an ongoing cultural resource management program in the area, and are in the process of assembling the data that have been collected over the past 15 years. Until this project is finished, complete site data for most of the hundreds of sites they have recorded will not become generally available.

The Panhandle region as a whole has benefited from the results of a number of studies implemented because of the National Environmental Policy Act of 1969. The focus of studies has been along the watercourses; however, many areas have received attention. Most work in the northern Panhandle is done at West Texas State University by Hughes and others at the Archaeological Research Laboratory.

Other significant publications of the 1970s are M. B. Collins 1971 review of the archaeology of the Llano Estacado, and Lintz's (1973, 1974, 1976, 1978a, 1978b) publications on the Panhandle Aspect village complexes.

Several masters theses and doctoral dissertations of the last decade deal with the Panhandle region including: Duffield (1970), Lintz (1975), Speer (1975), and D. Hughes (1977). Specifically applicable to this report is Upshaw's 1972 thesis on rock art sites in Palo Duro Canyon, where two of the nine localities described are sites in Randall County.

Investigations that have been carried out since 1977 include: a 1979-1980 survey by Hughes and others where 20 sites in Potter County are recorded; and a survey by Etchieson (1980) at Lake Meredith where 17 new sites are recorded in Potter County and 22 are recorded in Moore County. Relevant to the region, but not the study area, are the following: (1) test excavations at eight sites in the Red Deer Creek drainage (Hughes, Hood and Newman 1978); (2) test excavations at a site at Lake Meredith in Hutchinson County (Etchieson 1979); (3) survey of part of the North Palo Duro Creek drainage in Hansford County (Hughes 1979).

The southwestern portion of the Texas Panhandle has been studied less intensively than the northwestern portion; the following discussion has been taken with slight modifications from Campbell and Judd (1977: 7-9).

The earliest systematic archaeological investigation in the southwestern Panhandle was at the well-known Lubbock Lake Site under the direction of Joe Ben Wheat who conducted excavations here in 1939 and 1941; the first report by Wheat was published in 1940 (Kelley 1974:44; Wheat 1940:4-6, 1974:16). In the 1940s and 1950s, the Texas Memorial Museum renewed excavations at Lubbock Lake; the project was conducted by E. H. Sellards, Glen Evans, and Grayson Meade (Kelley 1974:46). In 1959-1960, projects were again undertaken here; this time by Texas Tech University, under the direction of Earl Green and Jane Holden Kelley. Texas Tech Museum Director Craig Black took direction of excavations at Lubbock Lake in 1973; this project continues to the present (Holden 1974:14). A symposium held in 1974 discussed discoveries made at the Lubbock Lake Site in the broader context of early man in North America (Black 1974:8). Since then, zooarchaeological studies at this site have been summarized (Johnson 1976a, 1976b). The Lubbock Lake constitutes the earliest and most intensively investigated site in the southwestern Panhandle.

Gravel quarrying in the city of Plainview in 1933 exposed a dense bison bone bed which was not excavated until 1944. A portion of the bed was excavated in the next year by E. H. Sellards, G. Evans, and others (Sellards, et al., 1947:928-292). This site was later radiocarbon dated to 7100 160 BP (Wormington, 1957:108) and is now known as the type site for the Plainview point, a well-known late Paleoindian projectile point.

Points continued to be found at the site into the 1960s, but no further work was done until 1976 when E. Guffee of the Llano Estacado Museum excavated the remnants of the bone bed (Guffee, 1974). The Plainview site was placed on the National Register in 1961.

Studies of sites and materials during the '30s and '40s provided information concerned with corner-tanged artifacts, ceramics, shaft tools, flint sources, and other artifacts and sites characteristic of the southwestern Panhandle (Kelley 1948; Patterson 1936; Pearce 1936; Watts 1939; Witte 1947). In these early decades of research, interest was most concerned with the Paleoindian period, the earliest time in which man was known to occupy the area (Fritz and Fritz 1940; Roberts 1936; Sayles 1935).

Following World War II, interest in a broader view of area prehistory began to unfold. During the 1950s, field research was undertaken near Mound Lake, Coyote Lake, Yellowhouse Canyon, and Lubbock Lake (Bryan 1953; Jennings 1953; Newcomb 1955; Wheat 1955). Field investigations increased during the '60s. Important excavations at the Andrews Lake Site, located south of the study area, and its report supplied significant data for Llano Estacado area prehistory (Collins 1966, 1968). Excavations and surface surveys and collections within the area provided additional important data (Brown 1968; Green 1961; Harper and Shedd 1969; Riggs 1965a, 1965b, 1966, 1968; Runkles 1964; Work 1963). In addition to the report of a burial from Yellowhouse Canyon in 1955 (Newcomb 1955) other burials were reported (Cockrum 1963; Shedd 1968; Suhm 1961), providing added details of prehistoric mortuary practices. Studies of rock art and unusual incised artifacts (Riggs 1965b, 1968; Watts 1965) as well as ceramics were reported (Collins 1969; Honen, 1973; Watts 1963) for the area. However, the interests of professional archaeologists continued to be largely concerned with the Paleoindian period (Green 1962; Trout 1963). Only Kelley (1964) made an attempt to define later periods of occupation.

In recent years, an additional burial has come to light (Word 1975) and studies of bedrock mortars have been initiated (Kirkpatrick 1977). Intensive surveys have increased (Guffee 1976; Guffee and Hughes 1974; Skinner 1973; Thoms and Proctor 1976) and intermittent survey and collecting continued (Hart 1975; Parsons 1967; Randall 1970; Riggs 1975). Further reports of progress at the renewed excavations at Lubbock Lake have now become available Bamforth, 1980; Black 1974; Johnson, C. 1974; Johnson, E. 1974, 1976a, 1978, 1980; Johnson and Johnson 1975).

CULTURE HISTORY (3.2.2)

This section taken from Speer 1980:28-41 with some modifications reviews the culture history of the Texas/New Mexico study area, beginning with the earliest, or Paleoindian stage and ending with the Neoindian historic stage.

Although modern man may have been living in the New World for as long as 30,000 years, his verifiable period of occupancy is about 12,000 years, based on radiocarbon dating of numerous archaeological sites (Haynes 1964). On the Southern Plains, three main archaeological stages of cultural development are recognized. These are the Paleoindian big game hunting stage of the late Ice Age, the Archaic foraging stage of the post-glacial period, and the Neoindian stage of developing horticulture. The stage when late Neoindian groups were coexisting and interacting with Euro-Americans can also be considered as part of the archaeological record, and in this report, it is so regarded.

A. Paleoindian Stage

The Paleoindian stage began about 12,000 years ago when the climate was cool and moist, and bands of hunters roamed the plains in search of wide variety of game animals including mammoth, extinct bison, camel, horse, and peccary. It ended about 7,000 years ago with the onset of warmer and drier climatic conditions that saw the big herds dwindle to extinction.

Faunal, floral, and geological evidence indicates that most early kills took place at stream, marsh, or pond localities where vegetation was lush, and both tall and short grasses grew nearby (Leonhardy 1966; Wendorf and Hester 1975; Johnson 1976; Fullington 1978). Other popular sites were the ubiquitous playas of the uplands, which, during the Paleoindian period, were larger, more numerous, and probably often full of water.

Three main cultural substages are recognized within the Paleoindian stage. From earliest to latest, there are the Clovis, Folsom, and Plano cultural periods. The cultures are distinguished from one another on the basis of distinctly different types of projectile points and by characteristic assemblages of other lithic tools.

1. Clovis Stage

The Clovis people hunted mammoth and other large extinct mammals using large, lanceolate, fluted Clovis points. Other typical Clovis culture tools are smaller non-fluted points, flake knives, scrapers, hammers, choppers, gravers, and bone implements. The time range for Clovis culture sites is from 12,000 to 11,000 years ago. These sites are widespread in North America, having been found on both the east and west coasts, as well as in the Great Plains and desert southwest. The type locality for the Clovis culture is Blackwater Locality No. 1, located near Portales, New Mexico (Hester, 1972). Other Clovis sites adjacent to the study area include the Miami Site in Roberts County (Sellards, 1952), the Lubbock Lake Site in Lubbock County (Johnson, 1976), the Domebo Site in southwestern Oklahoma (Leonhardy, 1966) and possibly the Rex Rodgers Site in Briscoe County (Hughes and Willey, 1978).

2. Folsom Stage

The Folsom people hunted extinct bison using relatively small, delicately made, lanceolate projectile points with flutes extending over nearly the entire surface of both blade faces. These points are typically found associated with leaf-shaped knives, knives made from channel flakes, abraders, gravers, bone tools and ornaments, and a variety of scrapers. The time range for Folsom sites is between 11,000 and 10,000 years ago, with most radiocarbon dates centering around 10,500 BP. Folsom sites are found mainly on the North American Plains. The type locality for the Folsom culture is the Folsom Site in northeastern New Mexico. Other Folsom sites in and adjacent to the study area are the Lipscomb bison quarry in Lipscomb County (Schulta, 1943), the Lake Theo Site in Briscoe County (Harrison and Smith, 1975), the Lubbock Lake Site, Blackwater Locality No. 1, and the Elida Site in Roosevelt County (Hester, 1962).

3. Plano Stage

The term "Plano" is applied to all of the post-Folsom period Paleoindian big-game hunting cultures of the North American Plains that are characterized by generally long, large, leaf-shaped or lanceolate projecticle points. The geographical and chronological range of this group is broad, and numerous projectile point types are associated with the various subcultures. Plano points can be subdivided into two groups: Plainview and parallel-flaked. The Plainview group are unfluted points generally resembling Clovis and Folsom in outline. The parallel-flaked group are frequently stemmed and include such types as Agate Basin, Scottsbluff, Eden, and Frederick. The associated artifact inventory is highly diverse; typical tools are choppers, hammers, perforators, several types of knives and scrapers, bone tools and ornaments, and also grinding stones. The latter may be significant, for they imply the presence of plant foods in the diet of the Plano peoples. Plano hunters were probably hunting the last of the extinct and first of the modern bison. Plano culture sites are found mainly in the Great Plains, and into the adjoining Rocky Mountains. Sites in and near the study area that are generally considered to have Plano affiliations include the Plainview Site in Hale County (Sellards et al., 1947; Guffee, 1976), the San Jon Site in eastern New Mexico (Roberts, 1941), the Lubbock Lake Site, Blackwater Locality No. 1, and the Milnesand Site in Roosevelt County (Sellards, 1955).

Evidence for Paleoindian occupation west of the Llano is limited to isolated finds of projectile points (Baker and Campbell, 1960; Jelinek, 1967), although a number of known camp and kill sites are relatively close to the valley and fairly extensive Paleoindian activity has been documented in the Rio Grande Valley to the west (Judge, 1973). There is some possibility that geological processes in the Pecos Valley have destroyed most of the Paleoindian sites there (Jelinek, 1967:140), but this remains to be demonstrated; at least one fairly large Paleoindian site, the Rattlesnake Draw Site (Smith, et al., 1966) has been found on the Mescalero Pediment near the Llano escarpment. The permanent water in the valley would have been a powerful attraction for hunters and gatherers at this time. Subsistence and settlement patterns during this period can be assumed to be similar to that of the adjacent parts of the study area - that is, strongly tied to areas near sources of water.

B. Archaic Stage

The Archaic stage on the Texas High Plains began about 7,000 years ago and ended early in the Christian era. Archaic Indians were hunters and gatherers who systematically exploited the resources of a particular territory as they became available with the changing seasons. Archaic cultures are characterized by a variety of types of dartpoints that probably were used with the atlatl or spearthrower. In the early part of the Archaic stage, a warm, dry (Altithermal) climate prevailed, but apparently about 4,000 years ago, the climate began to shift toward the more moderate (Medithermal) climate that presently prevails.

The Archaic cultures of the Texas High Plains are poorly known, but seem to be separable into two subcultures, an earlier one and a later one. The earlier sites are very scarce and difficult to identify. Most are small, open camps located near reliable sources of water. These sites are characterized by a scarcity of barbed dartpoints, and by only a few kinds of other artifacts, mostly gouges, hammers, choppers, and boiling pebbles. The gouges may be diagnostic for this period in the region. Bison and other large game animals are scarce, suggesting that they were absent from the region as Dillehay (1974:181) has postulated. The Bitter Creek Site in Hall County, Texas (Hughes and Hood 1976), may be representative of the early Archaic cultures on the High Plains.

One likely reason that early Archaic sites are scarce on the uplands may be that throughout the long drought of the Altithermal, existence was marginal, and based on a desert-like flora and fauna. Recent evidence suggests that during this stage, many groups may have deserted the uplands in favor of the more protected environment of the adjacent Rolling Plains to the east (Etchieson, Speer, and Hughes 1978 and 1979); however, Archaic remains, including wells at Blackwater Draw apparently dug during the Altithermal (Evans, 1951), are known from the Llano Estacado proper (Collins, 1971; Hester, 1972; Kung, 1969; Wheat, 1974). Reports of the presence of large numbers of gouges in the Canadian and Pecos river drainages hint at their presence in this area as well. Early Archaic foragers may also have relocated in the protected Canadian Breaks, where spring water must always have been available, and game probably collected. To date, sites with the diagnostic gouges have not been reported from this area; however, they may be due to selective field observation favoring the overridingly attractive and more conspicuous structure sites common in this region.

Sites of the late Archaic stage are numerous throughout some portions of the study area. They are small or large camps located at upland playas, along canyon and valley rims, and on the benches and terraces of stream valleys. Mortar holes are present at many camps, and slab-covered burials sometimes occur. Probably much quarry-workshop activity was carried on by late Archaic Indians and some bison bone deposits may represent late Archaic kills.

The later Archaic cultures are marked by quantities of corner-indented and corner-notched dartpoints, and by a large and varied artifact assemblage. This includes many ovate and trianguloid knives, thick and scrapers, small manos, thin grinding slabs, and numerous hearth stones and boiling pebbles. Bison and other large mammal remains are common, indicating that the big game animals had returned to the Southern High Plains, as Dillehay postulates. With the climate becoming more moderate, and supplies of food and water increasing, the uplands could have supported larger populations than during the Altithermal. The culture manifested at the Little Sunday Site in Randall County (Hughes 1955) may be typical of the late Archaic stage, in the Texas Panhandle.

A similar dearth of good evidence regarding Archaic occupations is present to the west. Northeastern New Mexico has produced apparently Archaic points (Baker and Campbell, 1960) from several surface sites and one excavated site (Pidgeon Cliffs - Steer, 1955) just north of the study area. Hammack (1965) suggests the presence of Archaic hunters in the vicinity of Ute Reservoir based on finds of Clear Fork gouges. To the south, the Pecos Valley appears to have been occupied throughout the Archaic period by hunters and gatherers. Jelinek (1967) suggests that the early Archaic populations in the area were more closely linked to the southwest while the later populations were more similar to those on the Plains, but little is known about the adaptations of either group. The nearby Llano Estacado may have been an important hunting area during this period, making canyons which offered relatively easy routes east, important areas.

C. Neoindian Stage

The Neoindian cultural stage on the South Plains began early in the Christian era and ended with the arrival of Coronado in 1541 A.D. The Neoindians were hunting and gathering people who gradually began to grow crops of corn, beans, and squash to supplement their diet. As horticultural activities increased, these groups gradually became more sedentary, their populations expanded, and the open camps of earlier days were replaced by large permanent villages. Neoindian cultures are characterized by the presence of pottery and/or arrowpoints.

In Texas, these cultures can be divided into earlier cultures and later cultures. In the Great Plains, early Neoindian cultures are considered part of a Plains Woodland tradition, and late Neoindian cultures part of a Plains Village tradition (Wedel, 1961). On the Southern High Plains, the early cultures are poorly known and have not been assigned to any tradition. The later cultures are assigned to the Panhandle Aspect Village tradition.

The earlier cultures are marked by the presence of several kinds of small, barbed arrowpoints such as Scallorn points, which are corner-notched, and Deadman points, which are notched from the base and tend to have long, slender barbs. In the northern part of the region, these points are sometimes associated with thick, parallel-corded pottery like that of Woodland cultures in the Central Great Plains, and sometimes with a plain brownware similar to Alma Plain that was imported from Mogollon cultures in southern New Mexico. The Woodland pottery is tempered with coarse particles of crushed rock or bone. The Mogollon pottery is tempered with particles of crushed plagioclase feldspar (Hughes, 1979:V16-17). The Lake Creek Site in Hutchinson County is one example of an early Neoindian site of the northern Southern High Plains (Hughes, 1962:65-84), and the term Lake Creek Culture is used to distinguish these sites from other early Neoindian sites.

Further south, the barbed points are usually accompanied only by the Mogollon brownware. This southern complex is present at the Deadman's Shelter in Mackenzie Reservoir where radiocarbon dating of charcoal yielded a date of 465-710 A.D. (Willey and Hughes, 1978:187). It is unreported, but present at three sites in the Palo Duro Canyon area, where radiocarbon dates are: 300-680 A.D. (Canyon City Club Site), 815-1110 A.D. (Blue Springs Shelter), and 370-870 A.D. (Chalk Hollow Site). The name "Palo Duro Culture" has been proposed for this complex (Willey and Hughes, 1978:187). To date, approximately 35 sites that may be assignable to the Lake Creek or Palo Duro cultures have been identified.

One characteristic feature of the early Neoindian cultures that may be significant is the presence of the prairie vole (Microtus ochrogaster) in most sites. The prairie vole no longer lives on the Southern High Plains, preferring moister regions to the east. This suggests that the climate locally may have been wetter around 500 A.D. than it is today. At some sites, other faunal remains such as soft-shelled turtle, raccoon, muskrat, and spotted skunk also suggest moister conditions. Bison are present at all of the sites except the Deadman's Shelter where they are inexplicably absent.

There are probably two late Neoindian cultures of the Texas Panhandle. The later of these, the Antelope Creek Focus (Krieger, 1946), is comparatively well known (see Lintz, 1978). It is a village complex that is especially numerous in the middle part of the breaks of the Canadian River across the Texas Panhandle, and appears to have been inhabitated from about 1150 to 1450 A.D. The complex is characterized by distinctive slab houses, several kinds of arrowpoints, including Washita, Harrell, and Fresno points, large oval-to-diamond-shaped (Harahey) knives, large thin-end scrapers, thick grinding slabs, large manos, cord-paddled pottery tempered mainly with crushed quartzonse rock (Borger Cordmarked), a wide variety of bone tools incuding awls and bison scapula, hoes, turquoise, obsidian, polychrome pottery, Olivella shell beads, and other distinctive artifacts of stone, bone, and shell.

The Antelope Creek Focus villagers planted their crops in the floodplain and on low terraces of the stream valleys of the Canadian Breaks and other stream valleys of the region. The preferred location for dwellings seems to have been high terraces, knolls, and butte tops. The areas within close proximity of the Alibates quarries were particularly attractive to the late villagers, for quarrying was a thriving industry. This activity doubtless strengthened the local economic base and enriched the cultural environment, as the flint was traded far and wide, thus effecting social contact with a variety of other cultures.

The Antelope Creek Focus culture complex was influenced by the Puebloan Culture to the west of the Texas Panhandle in eastern and northern New Mexico. This is seen in the use of stone slabs for building construction, and in the presence of such imported items as turquoise, obsidian, polychrome pottery, and shell beads. It also closely resembles cultures of the Plains Village tradition in many ways, including most of its architecture features and nearly all of its chipped stone, ground stone, ceramic, bone, and shell artifacts.

What became of the Panhandle Aspect people is not known. Apparently, their thriving and numerous villages had been abandoned for some 50 to 100 years before the arrival of Coronado. Possible causes for their demise are drought and/or increasing pressure from the Apaches. They may have been forced northward where they became part of the historic Pawnee in Nebraska (Hughes, 1974).

Some of the late Neoindian village sites of the Texas Panhandle appear to be earlier than those of the Antelope Creek Focus, and transitional out of Woodland into Antelope Creek in a manner analogous to the transition of Custer Focus out of Woodland into Washita River Focus in western Oklahoma (Lintz, 1974). Some attributes of these earlier sites may be primitive architecture, a minimum of tradeware, and thicker pottery reminiscent of Woodland ware. Such transitional sites probably should be included within the Panhandle Aspect, but distinguished from sites of the Antelope Creek Focus by assigning them to an earlier focus.

Puebloan ceramics associated with other Plains material culture and without permanent structures have been found near Ute Reservoir which appear to date to approximately A.D. 1250 to A.D. 1325 (Hammack, 1965). No preceding cultures, other than possible Archaic occupation (see above), could be defined by Hammack's work, although earlier remains adjacent to the Canadian River may be buried and his survey did not extend far onto the uplands (ibid.).

The ceramics on the basis of which these sites were dated were first identified further south in the Middle Pecos Valley (Jelinek, 1967). From approximately A.D. 800 to A.D. 1350, the Pecos Valley was occupied by increasingly sedentary agriculturalists, reaching a peak of population density between A.D. 1000 and A.D. 1250. Ceramic evidence links the earlier portions of this occupation to the Jornoda Magollon to the southwest, and, later, to the central and northern Rio Grande. Evidence for western influences virtually disappears by the period represented by the ceramics from Ute Reservoir, after A.D. 1100. Permanent sites, including multiple-room surface and subsurface slab-based structures, from this sedentary period occur on promontories, flat-topped hills, and terraces near modern and prehistoric rivers. Farming was practiced in river and stream bottoms, and larger sites tend to occur adjacent to large amounts of bottomland. Despite increasing reliance on agriculture in the valley during this period, hunting remained important; temporary camps occur near water sources on the Mescalero Pediment and up onto the Llano Estacado (Jelinek, 1967).

Very little is known of contemporary developments south of the middle Pecos Valley. However, a number of small pithouse sites identified with an eastward extension of the Jornoda branch of the Mogollon (Corley, 1965) have been found in the extreme southern part of the study area in Lea County as well as into adjacent parts of Texas and further towards the Rio Grande. These sites, including the Merchant Site (Leslie, 1965) and the Laguna Plata site (Runyan, 1972) appear to date from A.D. 950 to A.D. 1450 (Corley, 1965).

Between A.D. 1240 and A.D. 1350, agriculture was progressively deemphasized and finally abandoned. This progression is exactly the opposite of that predicted by most anthropological theory, particularly because the environmental evidence suggests that conditions became more favorable for farming at this time. The Pecos Valley inhabitants may have been taking advantage of the expansion in the size and range of the bison herds which occurred as a result of this same climatic shift; at any rate, this progression has important theoretical implications for archaeology. This development appears to have led the Pecos Valley people out onto the High Plains (Jelinek, 1967), possibly to sites such as the Salt Cedar Site (Collins, 1968). The Salt Cedar Site dates between A.D. 1000 and A.D. 1450. Pithouses appear after A.D. 1250 as well as an increase in the volume and variety of other remains present, particularly bison bone. Despite flotation and pollen analysis, no evidence of agriculture was found. Salt Cedar appear to represent full or nearly full sedentism based on bison hunting, occupied by people with strong Puebloan affiliations.

D. Historic Stage

The historic stage of Indian cultural development began with the arrival of Coronado in 1541. This stage has been extensively studied both historically and ethnographically, but has received little attention from archaeologists. Some probable Apache sites have been reported along the eastern caprock escarpment (Katz and Katz, 1976), and others from on the Texas High Plains (Holden, 1931; Johnson et al., 1977; Hughes, Hood and Newman, 1978). Some unreported sites in the Palo Duro Canyon are probable Apache sites or have Apache components. Numerous small, untested sites along Palo Duro Creek in Randall County contain polychrome pottery suggestive of Apache occupation. Some characteristics of Apache sites seem to be well made, thin, dark, sand-tempered pottery, often with mica; glazed polychrome pottery; well-made triangular arrowpoints; and large, functional scrapers. Extensive probable Apache occupation is known to the west in Quay and Harding Counties along the Canadian River and Ute Creek (Hammack, 1965).

Little is known of Comanche sites in the region. A probable Comanche camp in the eastern caprock escarpment is reported by Willey, Harrison and Hughes (1978:223-254). A rich Comanche burial site is reported from Floyd County on the Southern High Plains (Work and Fox, 1975:1-63). Part of a somewhat similar burial site was recently recovered in Briscoe County, but has not been reported. A possible Cc nanche site is reported from Hansford County near the study area (Hughes, 1979:V58).

The probable Comanche site in the caprock escarpment, called the Sand Pit Site, may be representative of Comanche sites in the region. The artifacts from this site are a mixture of prehistoric and Euroamerican objects. They include locally made and imported European gun flints; flint and metal arrowpoints; flint and metal knives; flint and metal scrapers (or flashers); and glass beads. Particularly significant may be some small, thin, tabular, sandstone wh.tstones with worn edges. These are unlike other whetstones from the region and probably were used for sharpening metal objects. Also unique are small, shallow "dinner plate size" fireplaces or ash lenses. The term "Sand Pit Culture" is proposed for these very late Neoindian sites.

The latest aboriginal occupation in New Mexico appears to take the form of tipi ring sites, found along the Canadian River and Ute Creek. These sites could represent camps of a number of tribes; military reports from this period specifically mention Comanche encampments in this area (Hammack, 1965). Unfortunately, the almost complete absence of artifacts associated with these rings makes specific ethnic identifications extremely tenuous. The Pecos River Valley to the south appears to have been unpopulated during this period (Jelinek, 1967).

CURRENT RESEARCH PROBLEMS (3.2.3)

The following discussion has been taken from Speers (1980:54-52) with some modifications.

Despite the number of investigations that have been done to date, the culture history of the region remains largely unknown. While the broad outlines of the main cultural stages and substages have been sketched, the painstaking process of filling in the gaps dealing with the nature and number of these substages is in its infancy, with progress frustratingly slow. Among the basic unknowns operating through both time and space are these: the nature of the physical environment; the cultural affiliations and basic chronological relationships of the various artifact types (projectile points, ground stone, pottery, etc.); the origin and ultimate fate of most groups. More complex problems relevant to all periods in and portions of the study area include the determination of: social organization, regional trade networks, subsistence/settlement systems, and extra-regional contacts. It cannot be stressed too strongly that the amount of systematic regional study which has been carried out is so small that virtually any research problem which can be successfully addressed would add significantly to our knowledge.

A. Paleoindian Stage

Some cultural stages of the region are better understood than others. One of these is the Paleoindian period. While interest in this group has always been high, the fairly recent development of sophisticated techniques for studying them has revitalized efforts, and the frequently common practice now is to adopt a multidisciplinary approach. This frequently includes geological, paleobotanical, microvertegrate, microinvertebrate, lithic tehcnological, and/or computerized osteological analyses. Examples of such studies are Frison (1970 and 1974); Wheat (1972 and 1979); Johnson (1976); and Agenbroad (1978).

Studies of this kind are directed toward clarifying such specific problems as changes through time and space on climate, morphological development in bison, lithic technology, and tool use. Among controversial problems are: the number of species of extinct bison hunted by early man and their ranges; the bone tools in common use; the evolutionary sequence out of Clovis of the various later projectile point types; the earliest dates for early man on the continent; the bison procurement techniques utilized by various groups; and the nature of the paleoenvironment. The study area is located in a region where answers to some of these questions may be forthcoming.

B. Archaic Stage

The regional Archaic stage is poorly understood, and the early stage (or stages) so little known that almost any information that can be gained will make a significant contribution to a better understanding of it. Basic to the problem are the questions of: What (if any) groups of foragers were in the study area, where were they, and when? What were their origins and their destiny? What was their lifestyle? These broad questions and the numerous others they imply are among the most important to be answered before the cultural history of the region can be synthesized.

Later Archaic cultures are better known by virture of being better represented, and using radiocarbon dating, projectile point typologies, and artifact assemblages, and other techniques, it is possible to address such questions as: were these groups mainly descendents of indigenous populations or were they newcomers that entered the area after food resources increased? Were they the first farmers, or did horticulturalists already farming in regions to the northeast and southwest begin to move into the Panhandle, causing the foragers to either leave the region or be assimilated into the farming population?

C. Neoindian Stage

Since it is just now beginning to be recognized that there may be more than one or two Neoindian cultures distinguishable in the study area, the basic questions asked for Archaic groups apply equally well to the Neoindian stage. The diagnostic attributes of the earliest groups have not been clearly established, but some research problems can be identified. For instance, did these groups evolve out of a local Archaic tradition, and if so, what was the nature of their associations with Southwest, Plains Woodland, and Puebloan groups? Were they practicing horticulture?

With the late Neoindian villagers of the Texas Panhandle, problems lie mainly with the earlier groups, or pre-Panhandle Aspect people, who are essentially unknown. The later Antelope Creek Focus villagers are less troublesome, having been investigated over many years. Specific questions relating to them are continuously being answered and replaced by others as Lintz's (1974; 1978) studies evolve.

The most pressing problems in other areas other than establishing an explicit chronology include: Detailing the changes in adaptation of the inhabitants of the Pecos River Valley after A.D. 1200 and determining the area(s) to which they migrated; establishing the nature of the occupation represented by sites on the

Llwano Estacado containing Puebloan ceramics; and the fate of the groups represented by these sites.

D. Historic Stage

The focus in research of this period has been the problem of linking archaeological collections to specific tribal groups. There is abundant documentation of the lifeways of these groups, but archaeological data could fill in gaps in our knowledge of migration routes and tribal boundaries, and contacts with other areas. Less concrete questions which have been addressed elsewhere with data from situations of contact between Anglos and aboriginal cultures include documentation of economic and social changes such contact causes.

Predicted Sensitive Areas for Archaeological Resources

The discussion of cultural listing allows the definition of types of areas which are likely to contain archaeological sites. Specific environmental zones were allocated to different levels of predicted sensitivity based on the expected significance of the cultural resources contained in them. High expected significance was evaluated on the basis of predicted high site density, high site integrity, and the probable applicability of potential data to a wide range of scientific problems. These allocations were made as follows:

1. Level 5 (High)

   o National Register Sites: Sites which are on the National Register are known to have great cultural and/or scientific value according to the guidelines which form the basis for all determinations of significance.

2. Level 4 (High)

   o Undisturbed draws on the Llano Estacado (a 1/4-mile zone along each side; the Llano draws may be up to 1/2 mile wide): These draws are known to contain as much as 25 ft of stratified cultural deposits spanning the entire known time range of human occupation in the area (Stafford, in press).

   o Undisturbed margins of permanent lakes, large and elongate plays lakes, and playa lakes with associated dunes (a 0.5 mile zone beyond their edges): These categories of water resources are likely to have existed for most or all of the period of human occupation in the area, and their immediate surroundings may therefore contain remains from any or all prehistoric and historic occupations (Reeves, 1966; Reeves and Parry, 1969, Hester, 1975; Collins, 1968).

   o Re-entrant canyons through the Llano escarpments (a 3-mile zone around them beyond the canyon rim): the Llano was probably an important hunting area during most periods, and canyons giving easy access on and off of it into adjacent areas were favored aboriginal camping places (C. F. Katz and Katz, 1976). These canyons were also access points for historic explorers, traders, and settlers, and formed shetlered areas for early historic settlements (Rathjen, 1974).

- o Dune area: sandy areas hold water at or near the surface and so would have attracted both animals and man; on the Llano, these areas would also have been the only places where unmechanized (i.e., aboriginal) agriculture would have been feasible (Collins, 1971; Krieger, 1946; Speer, 1980).

- o Undisturbed river and stream edges in the Pecos and Canadian River valleys and Panhandle High Plains (a 1-mi zone along each side): Neoindian and Puebloan agricultural villages and related sites tend to be located along the Pecos and Canadian Rivers and their tributaries, to take advantage of arable bottom land and water for irrigation (Jelinek, 1967; Lintz, 1978); historic Anglo and Spanish or Mexican settlements are also known to cluster along these drainageways for water, irrigation, and transportation (Kraenzel, 1955; Rathjen, 1973).

- o Previously recorded site clusters: those areas represent known resources which must form the basis for any future historical or archaeological work in the area.

3. Level 3 (Moderate)

- o Level 4 areas which have been seriously disturbed: partial or complete destruction of a site reduces its cultural and scientific value.

- o Margins of small playas (a 0.5 mi zone beyond the playa edge): small circular playas were formed in the relatively recent past, and so preserve remains from only the later periods (Reeves, 1966; Reeves and Parry, 1965).

- o A 0.75 mi zone along the Llano Estacado draws beyond the level 4 zones: this zone includes the uplands adjacent to the draws which were used for camping but which have been exposed to erosion rather than deposition (Stafford, in press; cf. Hester, 1971).

- o Gullies along the Llano escarpments: these features form natural traps for animals and so may contain kill/butchering sites from any period of aboriginal occupations; however, sites in active gullies may be eroded (df. Frison, 1978; Hughes and Willey, 1978).

- o A 1-mile zone along river and stream margins in the Pecos and Canadian River valleys and Panhandle High Plains beyond the level 4 zone: Neoindian and Puebloan villages, particularly the former, may be found at a greater distance from water when locations such as mesas which offer good defensive positions are available (Krieger, 1946; Speer, 1980).

4. Level 2 (Low)

- o Not used.

Table 3.2.3-1 shows the square miles of area at each level of predicted senstitivity by county in the Texas/New Mexico study area. These totals include

Table 3.2.3-1. Overall sensitivity for archaeology by county in the Texas/New Mexico region.

COUNTY	NO. OF RECORDED ARCHAEOLOGICAL SITES	OVERALL SENSITIVITY (MI^2)			
		LEVEL 4	LEVEL 3	LEVEL 2	TOTAL
Bailey	22	175	159	504	838
Castro	4	79	330	521	930
Cochran	2	27	111	700	838
Dallam	5	85	276	1,189	1,550
Deaf Smith	26	169	370	986	1,525
Hartley	11	78	216	1,231	1,525
Hockley	5	123	145	754	1,022
Lamb	34	167	165	690	1,022
Oldham	76	1,123	251	151	1,525
Parmer	7	133	293	489	915
Potter/Randall	700	829	429	617	1,875
Sherman	2	65	190	675	930
Swisher	70	53	331	546	930
Chaves	242	139	331	1,834	2,304
Curry	18	314	293	806	1,423
DeBaca	62	46	146	636	828
Harding	27	109	95	1,344	1,548
Lea	118	32	64	1,488	1,584
Quay	56	154	588	1,930	2,772
Roosevelt	41	186	282	1,441	1,909
Union	19	217	603	260	1,080

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* In or adjacent to study area.

only the northern half of Lea County, those portions of Chaves and De Baca counties east of the Pecos River, and that portion of Union County south of Route 66.

3.3 HISTORICAL AND ARCHITECTURAL RESOURCES

TEXAS/NEW MEXICO

Despite a large number of recorded non-aboriginal historic sites on the South Plains (Hughes, personal communication) and fairly extensive historic records for the area, very little is known about the resources there. There has been virtually no systematic investigation of non-Indian material remaining in the area; a recent summary of Llano Estacado research (Hughes and Willey, 1978) was able to catalog only five investigations of historic Euro-American sites. It is therefore difficult to make concrete statements regarding site types or densities of sites in particular regions. A records search to be done may provide a firmer basis for such an analysis.

The Historic period on the South Plains began in 1541 with the arrival of Colorado's expedition from Pecos (Winship, 1896). European presence in the area was largely limited to trading and exploring parties, and occasional missionary expeditions until 1786 (Collins, 1921; Guffee, 1976; Hughes and Willey, 1978; Rathjen, 1973). Indian-white relations during this period were marked by mutual hostility and frequent raids on the part of both groups; European presence in the area during this period of sufficient intensity to leave recognizable archaeological evidence is unlikely (Collins, 1971). A treaty between the Comanche and the Spanish in New Mexico in 1786, however, brought Spanish Ciboleros (bison hunters) onto the Llano. By the 1800s, these hunters were accompanied by traders known as Comancheros specializing in a lucratigve trade with the Comanche in horses, mules, slaves, rifles, knives, and iron (Guffee, 1976; Rathjen, 1973; Grinnel, 1923; Haley, 1935). Later Spanish occupants of the area included sheepherders, particularly in the western areas along and adjacent to the Canadian River, although also in the east, who were driven out by Anglo ranchers in the late 1800s (Guffee, 1976; Rathjen, 1973). One of the very few historic excavations on the South Plains was conducted in a Cibolero-Comanchero-sheepherder village in a re-entrant canyon on the east Cap Rock escarpment (Guffee, 1976); other such sites undoubtedly exist. There are also settlements from this period along the Canadian River (Hughes and Willey, 1978).

The buffalo were exterminated and the Indians put onto reservations by the late 1870s. During the early 1880s, the South Plains were largely free grazing lands for cattle and sheep settlements were few and occurred along permanent water. Total population in 1880 in the 11 northernmost counties in the Texas portion of the study area was less than 800, approximately three-fourths of them Spanish, concentrated in Oldham, Hartley, and Deaf Smith counties (Rathjen, 1973). By 1890, cattlemen had almost entirely replaced sheepherders, frequently by force, and large ranches replaced the free range; soon after this, the large ranches were broken up and sold, largely for farms. In addition, a railroad was completed from Fort Worth to Denver, through Amarillo into Potter, Oldham, Hartley, and Dallum counties, by 1888. Population aggregated around this railroad as well (Collins, 1971; Hughes and Willey, 1978; Rathjen, 1973).

The nature of the historic resources on the South Plains is suggested by the nature of the historic sites on the National Register. Most of these sites are homes, stores, or governmental buildings in existing towns. These buildings date to the later period of Anglo dominance in the area. The Register also includes ranch houses which probably date to the initial period of Anglo dominance, and isolated dugouts which could belong to the Spanish or later periods. However, small early Anglo villages are also known, particularly in or near re-entrant canyons along the edges of the Llano Estacado (Hughes and Willey, 1978).

The extremely limited data available precludes firm statements of sensitive areas. In general, many of the areas of aboriginal sensitivity are also of historic sensitivity. This includes areas adjacent to sources of permanent water, which can be expected to contain ranch houses, farm houses, ranching and farming outposts, specialized equipment such as watering troughs and windmills, and remains of trading or hunting camps from the earliest periods.

Because of the continuing desiccation of the area, some modern playas, particularly large ones, and now-ephemeral streams may have been good water sources in the recent past; the areas adjacent to these are also sensitive.

Re-entrant canyons can also be expected to contain approximately the same variety of resources and may be the most sensitive areas for sites from the Spanish and early Anglo periods. However, the ability to drill for water in the latest periods of historic occupation of the South Plains lessened the inhabitants' absolute reliance on surface water; many historic sites may exist in areas determined by ranching or farming needs rather than by surface geographic features. In addition, fence lines and roads may exist anywhere.

Predicted Sensitive Areas for Historical Resources

1. Level 5 (High)

   - National Register properties: sites on the National register are known to have great cultural and/or scientific value according to the guidelines which form the basis for all determinations of significance.

2. Level 4 (High)

   - Level 4 sensitive areas for historical resources are subsumed by those detailed for archaeology (see Section 1.2.2).

3. Level 3 (Moderate)

   - Level 4 areas which have been seriously disturbed: partial or complete destruction of a site reduces its cultural and scientific value.

   - All areas not designated as level 4 or level 5: the ability of historic inhabitants of the study area to drill for water allowed settlement in almost any part of the region; furthermore, resources such as fence lines and trails may exist almost anywhere.

4. Level 2 (Low)

   - Not used.

5. Level 1 (Low)

- o Not used.

Table 3.3-1 shows the square miles of area at each level of predicted sensitivity by county in the Texas/New Mexico study area. These totals include only the northern half of Lea County, the portions of De Baca and Chaves Counties east of the Pecos River, and the portion of Union County south of Route 66.

Some historical resources are primarily significant for architectural reasons. Although no comprehensive survey of this category of resources in the Texas/New Mexico region currently exists, several incomplete lists are available. These include the Texas and New Mexico State Registers of Historic Places and the Texas Tech University Historic Engineering Sites Inventory. The New Mexico State Register contains very few properties in the study area (Appendix C); however, the other two listings are extensive enough to provide a general description of the types of properties which might be determined to be architecturally significant.

Excluding sites with primarily archaeological or historical significance (such as the Altibates Flint Quarries in Potter County), the Texas Tech Historical Engineering Site Inventory (HESI) recorded 93 properties in the M-X study area (see Appendix C). Although this inventory is not exhaustive, it does define the general kinds of structures which may be significant from the perspective of engineering the kinds of areas in which they occur. Table 3.3-2 lists the frequencies of the various categories of structures and their association with relevant environmental features. The majority of these structures fall into categories relating to water control (irrigation systems, dams) and transportation (bridges, railroads). The high frequency of occurrence of these structures in association with rivers or streams is obviously primarily determined by the nature of these two categories.

The majority of these structures also fall roughly into three groups based on date of construction (see Figure 3.3-1): 1880 to 1890, 1900 to 1920, and 1920 to 1940. These groups correspond to major periods in the history of the area, the first being "the era of the cattlemen" (Rathjen, 1973:243), the second being a period of agricultural boom (Kraenzel, 1955:144-145) marked in the study area by the appearance of the railroads and the development of towns along them. The third is somewhat less clear, but of the 35 structures listed from this period, 25 are bridges and four are railroads: this group seems to work a major improvement in transportation systems in the area. Significant engineering properties, then, reflect both the critical concerns of the way of life in the Texas/New Mexico region in their emphasis on water control and transportation, and also the important periods in the history of that region.

Non-engineering architectural properties as compiled on the Texas State Register can be divided into two basic categories: rural and urban. The few rural properties which have been recorded date to the early ranching period, from approximately 1875 to 1905. Although the paucity of sites in this category is partly a function of the low intensity of historic occupation in this area, it is also a reflection of the lack of effort made to locate such properties; other such sites undoubtedly exist.

The far more numerous urban properties all date to periods before 1930, primarily before 1920. Thirty-five of the 45 properties in the state register are in

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Table 3.3-1. Overall sensitivity for historical resources by county in the Texas/ New Mexico region.

COUNTY	OVERALL SENSITIVITY $(MI)^2$		
	LEVEL 4	LEVEL 3	TOTAL
Bailey	175	663	838
Castro	79	851	930
Cochran	27	811	838
Dallam	85	1,456	1,550
Deaf Smith	169	1,356	1,525
Hartley	78	1,447	1,525
Hockley	123	899	1,022
Lamb	167	855	1,022
Oldham	1,123	402	1,525
Parmer	133	782	915
Potter/Randall	829	1,046	1,875
Sherman	65	865	930
Swisher	53	877	930
Chaves	139	2,165	2,304
Curry	314	1,099	1,423
DeBaca	46	782	828
Harding	109	1,439	1,548
Lea	32	1,552	1,584
Quay	154	2,518	2,772
Roosevelt	186	1,723	1,909
Union	217	863	1,080

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Table 3.3-2. Association of classes of significant engineering sites with environmental features.[1]

	RIVER OR STREAM	LAKE	RAILROAD	POPULATION CENTER	LOAD	NONE
Irrigation	14	-	-	4	-	-
Bridge	25	-	3	-	-	-
Dam	5	-	-	-	-	-
Railroad depot	-	-	-	2	-	-
Windmill	-	1	-	-	-	2
Air field	-	-	-	3	-	-
Water works	-	-	-	2	-	-
Ice plant	-	-	-	2	-	1
Electric station	-	-	-	2	-	-
Artificial lake	-	-	-	2	-	-
Rail line	-	-	-	-	-	12
Other[2]	2	-	-	3	1	7
	46	1	3	20	1	22

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[1]Includes all sites in HESI in counties in study area with the exception of prehistoric sites and sites whose significance is primarily historical (i.e., 19th century stone walls).

[2]Includes all those categories with only one representative in HESI.

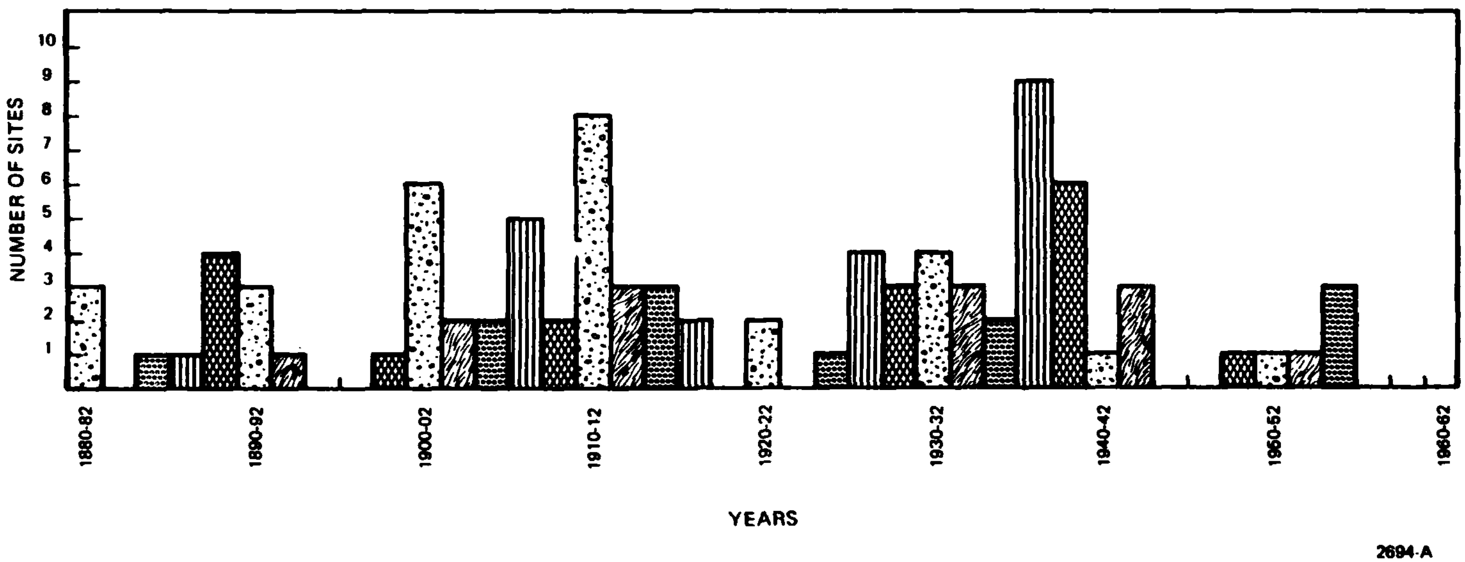

Figure 3.3-1. Frequency of entries in the HESI in the Texas/New Mexico study area by year.

Amarillo, pointing out the effect of concentrated population on both the probability of significant properties existing and the probability of those properties being recorded. Several patterns are obvious in these data. The first is that although there is no apparent difference in the range of ages of the properties between properties in and away from Amarillo, a somewhat higher proportion of the former properties date to the period from 1901 to 1929 (30 of 35, compared to 6 of 10). However, the bulk of the buildings named to the register from both kinds of communities represent exotic architectural sytles associated with some degree of affluence. This is particularly true of private dwellings on the register, which are most frequently Victorian or Classic Revival style. There are also slight differences between the kinds of architecturally significant properties in the two areas. Seven of the 10 buildings not in Amarillo are community structures such as churches or courthouses; only six of the 35 properties in Amarillo are of this type. Furthermore, both of the early period stone venacular structures on the Texas register are in small communities.

These patterns appear to reflect the pattern of economic and political development in the Texas Panhandle. Prior to the arrival of the railroads, centers of population in the Panhandle were relatively dispersed, and ranking was the primary economic activity. Overall population was low, and most of the inhabitants of the area were ranchhands or sheepherders, whose houses were unlikely to be sturdy or remarkable enough to be preserved. Significant structures from this period are limited to public buildings, such as courthouses, and major ranch structures. However, the success of the ranches in the area led to increased investment there and ultimately to the building of the railroad. By the end of the 1880s the first railroad through the Panhandle was completed; by 1910, railroad construction was over, and three major lines crossed it, intersecting at Amarillo. This intersection was a key factor in the emergence of Amarillo as the major center of the Panhandle in this period. Commercial development here led to greater affluence and consequently the construction of elite buildings (cf. Rathjen, 1973).

In general, then, available data suggest that major population centers, particularly Amarillo, contain a variety of public and private buildings which may be architecturally significant. These buildings are built in non-local styles and largely reflect the tastes of the social and political elite in the area during the early decades of the 205h century; the most common variety of structure is a well-preserved, fairly spectacular Victorian house or church. Less outstanding examples of this style of architecture such as the L. T. Lester House, a National Register Property in Randall County, may also be significant. Significant structures in local architectural styles are more likely to be present in smaller towns outside of the major areas of metropolitan development. Such structures are likely to be early period ranch buildings (which may be isolated situations rather than in a community) or public buildings, particularly municipal and religious edifices. However, the accuracy of this predicted distribution as well as the specific locations of significant structures can only be determined by systematic field inventory.

An aspect of architectural resources which has not been addressed by any listings in the study area is significance at a community level. Small communities which have not experienced extensive development may be expected to be architecturally more homogeneous than large towns, and may preserve their original style as a whole. While individual structures in such communities may not be significant in and of themselves, the community as a whole may provide an integrated example of the appearance of a town in an earlier period. The architectural style of such a community might therefore be worthy of preservation as a district.

3.4 IMPACT ASSESSMENT

Impacts were primarily assessed in terms of predicted sensitive areas. These areas were plotted on overlays to USGS 1:250,000 maps showing the conceptual M-X layouts. This procedure underestimates impacts because many sensitive areas do not show up at this scale. This is particularly true of areas associated with small playa lakes in the Texas/New Mexico region, a substantial proportion of which are not reproduced at 1:250,000. Some estimate of this problem can be seen in the region around the proposed OB at Cannon AFB. No sensitive areas appear at this scale; however, anlaysis using 7.5' USGS maps identified 10 playas in the direct impact area. Acreage of direct impacts to predicted sensitive areas was determined by counting the number of shelters and miles of DTN falling into these areas and then converting these totals to area by the assumptions presented in Table 2.5.2-3 of Section A. Impacts determined in this fashion were then totaled for each level of sensitivity within each county (Table 3.4-1).

Direct impacts will result primarily from land disturbance during the construction phase. Archaeological and historical resources frequently occur on, or buried slightly below, the present ground surface. They are thus subject to destruction by land modification activities related to the construction of M-X facilities and transportation corridors. This is most likely to occur when project elements occur along playas, or along river and stream edges in the Pecos and Canadian river valleys and the Panhandle High Plains. In some of these settings, especially within draws in the Llano Estacado, deeply stratified archaeological deposits are known to occur and may be subject to direct impacts.

Indirect impacts take several forms. Increased looting of sites exposed on the surface is certain to result from the increased population and increased access provided by the project road networks to previously isolated areas. Table 3.4-2 shows predicted M-X-related population increases by county. Panhandle Aspect sites along the Canadian and North Canadian rivers and their tributaries are particularly subject to indirect impacts because they tend to be easily visible standing structures. Serious indirect impacts to the Alibates Flint Quarries, 30 mi north of Amarillo, a National Register Site and National Monument open to the public, can also be expected. These quarries, which provided a critical resource to aboriginal populations for 12,000 years, have never been adequately studied. In addition to the damage to archaeological resources caused by looting, the site is vulnerable to large-scale damage as individuals illegally collect large quantities of the brightly colored flint for commercial purposes.

Other archaeological sites on the National Register which may be subject to indirect impacts include Rocky Dell and Landergin Mesa, both in Oldham County (Table 3.4-3). A fourth site, the Blackwater Draw/Anderson Basin archaeological district in Roosevelt County, may be subject to direct impacts resulting from gravel quarrying in its vicinity to supply construction at the proposed Clovis OB.

Preconstruction archaeological surveys, however, would have the effect of significantly increasing scientific knowledge on human occupations in this relatively unstudied region.

Table 3.4-1. Approximate square miles of direct adverse impacts to archaeologically and historically sensitive areas in the Texas/New Mexico region resulting from full-basing deployment.

COUNTY	DIRECT ADVERSE IMPACTS (MI^2)				
	LEVEL 4	LEVEL 3 ARCHAEOLOGY	LEVEL 3 HISTORY	LEVEL 2	TOTAL
Bailey	.43	.36	8.94	8.58	9.37
Castro	.54	2.95	10.91	7.96	11.45
Cochran	.29	1.54	4.74	3.2	5 03
Dallam	6.03	6.5	41.32	34.82	47.35
Deaf Smith	4.7	8.3	39.53	31.23	44.23
Hartley	2.7	2.13	25.22	23.09	27.92
Hockley	.29	.17	.92	.75	1.21
Lamb	.02	.67	3.28	2.61	3.3
Oldham	.13	.67	4.38	3.71	4.51
Parmer	1.96	4.4	10.7	6.3	12.66
Potter/Randall	.48	1.0	3.68	2.68	4.16
Sherman	.56	.58	3.6	3.02	4.16
Swisher	.1	.17	2.33	2.16	2.43
Chaves	4.5	4.96	33.66	28.7	38.16
Curry	3.6	4.3	10.5	6.2	14.1
DeBaca	.1	0.0	7.18	7.18	7.28
Harding	7.2	2.9	8.58	5.68	15.78
Lea	0	.39	1.21	.82	1.21
Quay	3.2	2.8	30.8	28.	33.99
Roosevelt	3.51	11.3	40.2	28.9	43.71
Union	.49	.31	16.16	15.85	16.65

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Table 3.4-2. Predicted population increase and urban land requirements as a result of the full basing alternative in Texas/New Mexico region.

COUNTY	MAXIMUM PERCENT POPULATION INCREASE*	SUSTAINED POPULATION INCREASE*	REQUIRED URBAN ACREAGE
Bailey	36.3	0.0	228
Castro	3.6	0.0	58
Cochran	2.4	0.0	17
Dallam	172.2	20.2	1244
Deaf Smith	25.9	0.0	432
Hale	1.9	0.0	99
Hartley	347.7	242.9	1072
Hockley	2.2	0.0	65
Lamb	1.2	0.0	30
Lubbock	2.3	0.0	819
Moore	21.5	10.1	460
Oldham	4.9	0.0	19
Parmer	37.5	0.0	271
Potter/Randall	8.7	1.4	2082
Sherman	17.8	0.0	103
Swisher	1.2	0.0	18
Chaves	10.2	0.0	550
Curry	60.0	43.0	2492
DeBaca	4.7	0.0	16
Harding	601.2	0.0	537
Quay	49.1	0.0	485
Roosevelt	36.1	4.7	617
Union	3.4	0.0	23
			3720

*Caused by M-X

Table 3.4-3. Potential impacts to National Register sites and districts for both full basing system and split basing options in Texas/New Mexico.

PROPERTY NAME	DESCRIPTION	COUNTY	STATE	IMPACTS
Landergin Mesa	Panhandle aspect village 1300-1450 A.D.	Oldham	Texas	Indirect impacts are likely from ORV's, looting, vandalism and increased traffic to the areas. Landergin Mesa is about 15 miles from the deployment area.
Rocky Dell	Petroglyph Site	Oldham	Texas	3 miles from deployment area (see Landergin Mesa for indirect impacts).
Alibates Flint Quarries	Archaeological District	Potter	Texas	Adjacent to Lake Meredith Recreation Area; see Landergin Mesa for impacts.
Anderson Basin (Blackwater Draw)	Archaeological District	Roosevelt	New Mexico	About 6 miles from Cannon Air Force Base. This district could be directly impacted by gravel quarrying.

3616

Because archaeological resources are non-renewable, mitigation of direct impacts is best accomplished by avoidance through redesign. This will require intensive field surveys in proposed construction areas and evaluation of the National Register eligibility of all cultural resources encountered. Data recovery programs may be required to mitigate unavoidable impacts. However, the large size of the M-X project implies that large numbers of sites may be impacted over a short period of time. Because of the constant increases in the sophistication of archaeological field procedures through time and the wide range of problems to which these sites may be relevant, such a resource loss cannot be adequately mitigated by data recovery, and constitutes a probable irretrievable resource commitment.

Historic resources in construction areas may be subject to direct adverse effects; this could include all classes of structures and features (including trails or travel routes, fence lines, windmills, and other ranching and farming facilities as well as houses). All historic resources in the study area will be subject to indirect impacts in the form of increased looting and vandalism as a result of induced population growth in and increased access to previously isolated areas, particularly in the vicinity of the OBs. This is especially true due to the highly visible nature of most historic sites.

Most of the land in the Taxas/New Mexico study area is privately owned and ranched or farmed. Buildings can therefore be expected to occur throughout the area. These rural resources may be adversely impacted since project construction could require their removal.

Rural communities as well as larger towns may be affected by project-induced population increases. The need for new housing and other facilities could result in the remodeling or demolition of existing properties or in the construction of buildings whose appearance is incongruent with the existing style of architecture, thereby reducing the significance and integrity of older structures. Potential adverse effects could be tempered by appropriate community planning, zoning, or other control measures.

CLOVIS

Specific information on the locations of archaeological and historical resources at the Clovis OB site is not currently available; however, the proposed construction site at Cannon Air Force Base lies in an area known to have been inhabited by hunter-gathers for at least the last 12,000 years. Although only 18 archaeological sites have been recorded in Curry County, many others are certain to exist. Roosevelt County, where more research has been done, contains 296 recorded sites, one of which is on the National Register.

Historic incursions began in 1540, with Spanish trading, missionary, and exploring expeditions. Sites from this period near the proposed base may be located near water sources. Ranching began in the 1880's, and was predominant until the early 1900's, when many ranches were subdivided into farms.

The proposed Clovis OB would impact ten playa lakes, which have a moderate sensitivity for archaeological and historical resources. These playas are scattered around the periphery of the proposed expansion area, and the designated suitability zone is too small to permit avoidance through redesign. A possible ancient tributary of Blackwater Draw, a high sensitivity area, immediately abuts the proposed OB.

The long-term increase in population that will result from siting an OB near Clovis will be a major source of indirect impacts to cultural resources in the region. Impacts to significant architectural resources are unlikely to occur at Cannon Air Force Base; however, population increase in Clovis may cause impacts to resources there. One National Register site, Blackwater Draw/Anderson Basis, is located approximately 5 miles south of the proposed Clovis OB. This site is a privately owned known source of gravel and could be impacted if selected as a gravel quarry for OB construction.

Mitigation of potential impacts to resources in the construction area could be accomplished by avoidance and preservation. However, very little room for redesign has been allocated for the Clovis OB. If field survey were to locate significant resources in the predicted sensitive areas and these resources could not be avoided a comprehensive program of data collection and analysis would be required. Impact to architectural resources in Clovis may be mitigated by preservation of significant structures and by design of new buildings in accordance with the existing styles.

Because direct and indirect impacts of registered or eligible properties are anticipated and because archaeological or historical properties may be encountered during construction, a program to identify and, to the extent possible, preserve these resources is planned. The Advisory Council on Historic Preservation and the Air Force have prepared a Programmatic Memorandum of Agreement which is now under negotiation.

DALHART

OB construction near Dalhart is not expected to have a direct impact on any sites currently listed in the National Register of Historic Places. However, predicted high sensitivity areas occur in close proximity to the proposed OB location. Permanent village sites are present along the Canadian River and its tributaries, and a variety of camping and kill sites are undoubtedly present on the Plains themselves, probably close to water sources. Approximately 21 percent of the area within Dallam and Hartley counties is of predicted moderate or high sensitivity.

Intermittent Spanish and Mexican contact with this area from 1541 until the 1800s, in the form of trading, exploring, and missionary expeditions, probably left historic archaeological remains near water sources and in protected drainages. Permanent Anglo settlement in the area did not occur until the late 1800s when the area was mainly used for ranching. During the early 1900s a number of farms and farming communities appeared.

In the northern preferred construction area, there are two large playas which would be impacted by OB construction. Playas have a predicted moderate sensitivity for archeological and historical resources. The southern preferred construction area infringes upon the Punta de Agua Creek and would impact areas of predicted high and moderate sensitivity.

The southern portion of the suitability zone impacts the headwater of Romero Spring Creek and a playa, considered high and moderate predicted sensitivity areas, respectively. The area on the west side of highway 54 is apparently free of areas of potentially high archaeological and historical sensitivity.

Anticipated extensions of the airfield impact a moderately sensitive area around a playa. Similar areas are scattered thorugh the southern part of the suitability zone; its eastern edge passes thorugh highly and moderately sensitive areas along Rita Blanca Creek.

Impacts to significant architectural resources may occur in Middle Water and Dalhart, and population increase in the Dalhart vicinity will result in indirect impacts to cultural resources in the area, particularly along Rita Blanca and Punta de Agua Creeks. One National Register site south of the proposed site in Oldham County, Landergin Mesa, may also be subject to similar impacts.

Mitigation of direct impacts can be accomplished in a manner similar to those at the Clovis OB. The close proximity of Punta de Agua Creek to the construction area renders resources there vulnerable to short and long-term indirect impacts, and data recovery may be required to mitigate this effect. Impacts to architectural resources may be mitigated by preservation of significant structures and design of new buildings in accordance with existing styles.

Because direct or indirect effects on registered or eligible properties are anticipated and because archaeological and historical sites may be encountered during construction, a program to identify and, to the extent possible, preserve these resources is planned. The Air Force and the Advisory Council on Historic Preservation have prepared a Programmatic Memorandum of Agreement which is now under negotiation.

Split Basing Alternative 8

Table 3.4-4 shows the approximate square miles of archaeologically and historically sensitive area subject to direct adverse impact as a result of split basing M-X deployment. This alternative reduces impacts on the Llano Estacado in Texas, particularly to the highly archaeologically sensitive draws in that area. However, the split basing scheme does not reduce potential impacts to National Register sites over the full basing option (Table 3.4-3). Probable architectural impacts as a result of population increase (Table 3.4-5) are also reduced.

Alternative 8 also eliminates the Dalhart OB, which had greater predicted impacts to archaeological and historical resources than the Clovis OB.

Impact Significance

The relative sensitivity of and signifance and degree of impacts to the counties in the Texas/New Mexico region were evaluated as follows:

a. Relative sensitivity was treated as a function of the square miles of predicted sensitive area in a county. Areas of high predicted sensitivity are the same for archaeology and history. However, the lack of knowledge regarding historical resources in the area resulted in the definition as moderately sensitive for these resources of all land in the area not defined as highly sensitive. Without better data, this was regarded as the safest option. However, to evaluate resource abundance, only moderately sensitive area for archaeology was added to highly sensitive area; if history had been included, this would have totalled 100

Table 3.4-4. Overall sensitivity and approximate square mi of direct adverse impacts to archaeologically and historically sensitive areas in the Texas/New Mexico region resulting from split basing M-X deployment.

COUNTY (Split Basing)	DIRECT ADVERSE IMPACTS (MI^2)				
	LEVEL 4	LEVEL 3 ARCHAEOLOGY	LEVEL 3 HISTORY	LEVEL 2	TOTAL
Bailey	.26	.23	.59	.36	.85
Cochran	.17	.99	4.15	3.16	4.32
Dallam	1.72	.81	16.12	15.31	17.84
Deaf Smith	1.31	1.35	16.7	15.35	18.01
Hartley	2.62	1.98	15.22	13.24	17.84
Hockley	.29	.37	.91	.54	1.2
Lamb	—	.20	.59	.39	.59
Oldham	.36	.30	1.42	1.12	1.78
Chaves	4.5	4.96	32.96	28	37.46
Curry	.91	.85	2.66	1.81	3.57
DeBaca	.1	—	7.39	7.39	7.49
Harding	1.09	.95	15.14	14.19	16.23
Lea	—	.39	1.25	.86	1.25
Quay	1.16	1.47	22.33	20.86	23.49
Roosevelt	1.11	.64	13.6	12.96	14.71
Union	.68	.44	11.95	11.51	12.63

3721

Table 3.4-5. Predicted population increase and urban land requirements as a result of the split basing alternative in the Texas/New Mexico region.

COUNTY	MAXIMUM PERCENT POPULATION INCREASE*	SUSTAINED POPULATION INCREASE*	REQUIRED URBAN AVERAGE
Bailey	6.1	.0	76
Castro	2.2	.0	32
Cochran	2.1	.0	15
Dallam	47.6	.0	313
Deaf Smith	15.5	.0	228
Hale	.3	.0	18
Hartley	80.8	.0	266
Hockley	.9	.0	30
Lamb	1.0	.0	25
Lubbock	1.6	.0	544
Moore	1.8	.0	34
Oldham	2.1	.0	10
Parmer	.4	.0	3
Potter/Randall	2.2	.1	558
Sherman	.0	.0	0
Swisher	.6	.0	11
Chaves	8.5	.0	469
Curry	55.4	42.4	2295
DeBaca	4.9	.0	16
Harding	543.9	.0	467
Quay	42.0	.0	443
Roosevelt	31.1	4.6	536
Union	.0	.0	0
			3722

*Caused by M-X

percent of the land in each county, precluding comparisons. Where this total was 40 percent or more of the total land in a county, sensitivity was noted as "high"; 10 to 39 percent was considered "moderate"; and below 10 percent was considered "low".

b. Impacts were divided into direct and indirect and evaluated independently. Direct impacts were determined by the method described above, and were categorized as high (greater than 15 mi^2), moderate (5-15 mi^2), and low (less than 5 mi^2).

Indirect impacts to cultural resources in a county were assumed to increase in response to five variables which describe both those resources and the nature of the proposed M-X activities in that county. These variables included:

- High site visibility: More spectacular remains such as above-ground villages, rock art, historic ghost towns, or ranching and farming structures are assumed to attract looters and vandals.

- Abundant resources (see above): A greater abundance of resources in a county was assumed to result in a generally higher rate of indirect impacts.

- Presence of recreational facilities: Such facilities attract people to them, increasing potential impacts to resources in their area.

- Presence of a construction camp: The siting of either of these facilities in a county will substantially increase its population, leading to a higher probability of damage to resource in it. An area with a 50 mi radius around these proposed facilities was considered to be subject to slightly less severe indirect impacts due to this increased population than the county in which the increase will actually occur.

- Number of proposed clusters in a county: Construction of the M-X DTN will provide a means of obtaining access to many heretofore fairly isolated areas, increasing to likelihood of indirect impacts caused both by M-X-related personnel and the general public. This variable was categorized on the basis of total amount of disturbed area in a county into many clusters (greater than 15 mi^2 disturbed area), a moderate number of clusters (5-15 mi^2 disturbed area) and few clusters (less than 5 mi^2).

These variables were used to evaluate potential short-term indirect impacts due to system deployment as follows:

- Very high: Counties with moderate or high resource abundance in which a construction camp and many clusters are located.

- High: Counties with moderate or high resource abundance in which a construction camp or many clusters are located, or which will contain only a moderate number of clusters but which also have recreation areas and high visibility sites which will attract visitors.

- o Moderately high: Counties which are within 50 mi of three or more construction camps, or which have high site visibility and are within 50 mi of less than three construction camps, or which have high site visibility and have only a few clusters in them.
- o Moderate: Counties which will contain only a few clusters or which are within 50 mi of less than three construction camps.
- o Low: Counties with no M-X-related construction proposed which are not within 50 mi of any construction camp.

The same five variables were used to evaluate indirect impacts due to OB construction. These categories are as follows:

- o Very high: Counties with moderate or high resource abundance in which an OB is located.
- o High: Counties with low resource abundance in which an OB is located.
- o Moderately high: Counties with moderate or high resource abundance within 50 miles of an OB.
- o Moderate: Counties with low resources abundance within 50 mi of an OB.
- o Low: Counties more than 50 mi from an OB.

The evaluation of potential long-term indirect impacts considered the number of clusters proposed for each county, the abundance and visibility of the resource in that county, the presence of recreational facilities in that county, and its proximity to an OB.

- o Very high: Counties with moderate or high resource abundance which are within 50 mi of an OB and contain many clusters.
- o High: Counties with moderate or high resource or high site visibility which are within 50 mi of an OB or which contain many clusters.
- o Moderately high: Counties which contain recreational facilities or moderate numbers of clusters or which are within 50 mi of an OB.
- o Moderate: Counties which have high site visibility or resource abundance and few clusters but are more than 50 mi from an OB.
- o Low: Counties with low site visibility and resource abundance which are more than 50 mi from an OB and contain no clusters.

Overall short-term impacts were evaluated by scaling the possible levels of direct and indirect impacts by the criteria shown in Table 3.4-6, summing the two values for each county, and applying the decision criteria (also shown in Table 1.4-6). Because cultural resources are non-renewable, overall long-term impacts can never be less than overall short-term impacts. Long-term impacts differ from short-term impacts only if the evaluated long-term indirect impacts are higher than

Table 3.4-6. Scales and decision criteria for overall impact evaluation.

VALUE	DIRECT IMPACTS	INDIRECT IMPACTS	SUMMED IMPACTS (DECISION CRITERIA)
0	None	None	0
1	Low	Low	1-2
2		Moderately low	3-4
3	Moderate	Moderate	5-7
4		Moderately high	8-9
5		High	10-12
6	High	Very high	

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the overall short-term impacts; overall long-term impacts for each county were evaluated by using Table 3.4-6 again, combining the values for long-term impacts and overall short-term impacts, and applying the same decision criteria.

Despite the relatively low direct impacts in a county caused by OB construction, indirect impacts due to the OBs will be of a far greater magnitude than those just considered because the population increase in their area is several times greater than that occurring anywhere else and that increase is permanent. Overall impacts in this category were therefore evaluated on the same scale as DDA impacts and then raised one step on the scale to take this into account.

To render the results of this procedure comparable with those of other disciplines, these six categories (see Table 3.4-6) were reduced to four. "High" includes high and moderately high input levels, "moderate" includes moderate and moderately low impact levels, and "low" and "none" remain unchanged.

Summaries of impacts in the Texas/New Mexico area for Alternatives 7 and 8 are shown in Tables 3.4-7 and 2.4.2-3.

Table 3.4-7. Potential impact to cultural resources in Texas/New Mexico DDA for Alternative 7.

COUNTY	RELATIVE SENSITIVITY	SHORT-TERM EFFECT: DISTURBANCE OF ARCHAEOLOGICAL AND HISTORICAL SENSITIVITY AREAS (SQ MI)	SHORT-TERM EFFECT: POTENTIAL IMPACT	LONG-TERM EFFECT: POTENTIAL IMPACT
Counties with M-X Clusters				
Bailey, TX	Moderately high to high	9.37	Moderately high to high	Moderately high to high
Castro, TX	Moderately high to high	11.45	Moderate	Moderately high to high
Cochran, TX	Moderate	5.03	Moderate	Moderately high to high
Dallam, TX	Moderate	47.35	Moderately high to high	Moderately high to high
Deaf Smith, TX[2]	Moderate	44.23	Moderately high to high	Moderately high to high
Hartley, TX[2]	Moderate	27.92	Moderately high to high	Moderately high to high
Hockley, TX	Moderate	1.21	Moderate	Moderate
Lamb, TX	Moderate	3.30	Moderate	Moderate
Oldham, TX	Moderately high to high	4.51	Moderate	Moderately high to high
Parmer, TX	Moderate	12.66	Moderately high to high	Moderately high to high
Randall, TX	Moderately high to high	4.16	Moderate	Moderate
Sherman, TX	Moderate	4.16	Moderate	Moderately high to high
Swisher, TX	Moderately high to high	2.43	Moderate	Moderately high to high
Chaves, NM	Moderate	38.16	Moderately high to high	Moderately high to high
Curry, NM	Moderately high to high	4.10	Moderate	Moderately high to high
DeBaca, NM	Moderate	7.28	Moderate	Moderately high to high
Harding, NM	Moderate	15.78	Moderately high to high	Moderately high to high
Lea, NM	Low	1.21	Moderate	Moderate
Quay, NM	Moderate	33.99	Moderately high to high	Moderately high to high
Roosevelt, NM[2]	Moderate	43.71	Moderately high to high	Moderately high to high
Union, NM	Moderately high to high	16.65	Moderately high to high	Moderately high to high
Other Affected Counties				
Cimarron, OK	Moderate		Moderate	Moderate
Texas, OK	Moderate		Moderate	Moderate
Armstrong, TX	Moderately high to high		Moderate	Moderate
Briscoe	Moderately high to high		Moderate	Moderate
Carson	Moderately high to high		Moderate	Moderate
Floyd	Moderate		Moderate	Moderate
Hale	Moderate		Moderate	Moderate
Hansford	Moderate		Moderate	Moderate
Hutchinson	Moderately high to high		Moderate	Moderate
Lubbock	Moderate		Moderate	Moderate
Moore	Moderately high to high		Moderate	Moderate
Potter	Moderately high to high		Moderate	Moderate
Terry	Moderate		Moderate	Moderate
Yoakum	Moderate		Moderate	Moderate
Guadalupe, NM	Moderately high to high		Moderate	Moderate
San Miguel, NM	Moderately high to high		Moderate	Moderate
Overall DDA	Moderately high to high		Moderately high to high	Moderately high to high

3903-3

[1]

- No impact.
- Low impact.
- Moderate impact.
- Moderately high to high impact.

[2]Conceptual location of Area Support Centers (ASCs).

APPENDIX A

CULTURAL RESOURCES PROGRAMMATIC MEMORANDUM OF AGREEMENT

The following is the current text of the proposed Programmatic Memorandum of Agreement. The document has not as yet been executed by all concerned parties, although the Advisory Council on Historic Preservation and the United States Air Force have both signed the current document. Since this language could change slightly before finalization, it is not possible to reproduce the actual document at this time.

WHEREAS, the United States Air Force, Department of Defense, proposes to deploy the M-X system (undertaking) within the States of Nevada, New Mexico, Texas, and/or Utah; and,

WHEREAS, the M-X system may be deployed on land managed by the Bureau of Land Management (BLM), and BLM and the Air Force have management responsibilities, with regard to historic properties pursuant to Executive Order 11593, and the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 47 of, as amended, 90 Stat. 1320); and,

WHEREAS, the Air Force has assumed lead agency status and primary responsibility for compliance with the historic preservation statutes and regulations referenced herein on behalf of both itself and BLM;
and,

WHEREAS, the Air Force, in consultation with the State Historic Preservation Officers (SHPOs), has determined that the proposed undertaking could have effects upon historic and cultural properties included in or eligible for inclusion in the National Register of Historic Places (Register); and,

WHEREAS, pursuant to Section 106 of the National Historic Preservation Act of 1966, Section 2(b) of Executive Order 11593, and Section 800.4 of the regulations of the Advisory Council on Historic Preservation (Council), "Protection of Historic and Cultural Properties" (36 CFR Part 800), the Air Force has requested the comments of the Council; and,

WHEREAS, pursuant to 36 CFR Sec. 800.8(a) of the Council's regulations, the Air Force has requested development of a Programmatic Memorandum of Agreement (Agreement); and,

WHEREAS, the Air Force, the Council, BLM, and the SHPOs of Nevada, New Mexico, Texas, and Utah have consulted and will continue to consult and review the undertaking to consider feasible and prudent alternatives to avoid, minimize, or satisfactorily mitigate adverse effects,

NOW, THEREFORE, it is mutually agreed that implementation of the undertaking in accordance with the following stipulations will avoid or satisfactorily mitigate its adverse effects on historic and cultural properties.

Stipulations

The Air Force will ensure that the following measures are carried out.

I. General

A. The Air Force will establish a Review Committee to assist in oversight of all historic preservation related M-X activities to ensure that such activities meet high standards of professional methodology. The committee will report to the Executive Director of the Council and to the Air Force, and will act and be funded in accordance with Attachment 1.

B. The Air Force will afford the appropriate SHPOs, and the state offices of BLM, opportunity to review and comment on all scopes of work, and significant revisions of such scopes, relating to historic preservation; and the opportunity to review and comment on the historic preservation reports or products generated under this Agreement. Informational copies of these documents will be provided to the Council.

C. The Air Force will provide data generated under this Agreement to the appropriate SHPOs and state offices of BLM.

D. The Air Force, in consultation with appropriate SHPOs, will notify the public of intended significant actions under this Agreement, will provide timely notice to news media, and will afford the public the opportunity to comment to the Air Force, the SHPOs, or the Council regarding these actions.

E. The Air Force, in consultation with the appropriate SHPOs, will ensure that all historic preservation activities are carried out by or under the supervision of, qualified persons as prescribed in 36 CFR Sec. 1201.5.

F. The Air Force will ensure that all stipulations of this Agreement are met by its contractors as well as by all participating units of the Air Force.

G. The Air Force, in consultation with the appropriate SHPOs, will ensure that its contractors and Air Force personnel and resident dependents are advised against illegal collection of historic and prehistoric materials, will encourage those with interests in such materials to participate in nondestructive activities, and will cooperate with BLM to ensure enforcement of the Archaeological Resources Protection Act of 1979.

H. Pursuant to 36 CFR Sec. 800.8 of the Council's regulations, the Air Force will submit an annual report to the Council, the SHPOs, and to Interagency Archaeological Services (Heritage Conservation and Recreation Service, Department of the Interior) on all actions taken pursuant to this Agreement.

I. The Air Force will provide data to assist the SHPO's in identifying and documenting the budgetary and staff impacts arising from this undertaking.

II. Identifying and Mitigating Adverse Effects of Construction and Operation

A. In consultation with BLM and the appropriate SHPOs, and in accordance with the guidelines in Attachment II, the Air Force will locate and identify historic properties in the potential impact area, determine their significance, and assess the undertaking's impact upon them by:

1. Development of an initial study plan, including but not limited to:

   (a) definition of preliminary study goals;

   (b) establishment of study methods;

   (c) indication of predicted types of historic and cultural properties;

   (d) establishment of study team composition;

   (e) establishment of programs for data storage, management and use which are, to the extent feasible, compatible with existing state and BLM systems;

   (f) development of a calendar of tasks (see Attachment II).

2. Conducting preliminary studies based on the study plan, including background data and field inspection of sample areas during initial environmental analyses of the potential impact areas, to predict where adverse effects upon historic and cultural properties are likely to occur.

3. Development and implementation of a plan for intensive field survey of all locations where adverse effects upon historic and cultural properties are likely to occur in the vicinity of potential M-X permanent and temporary facilities such as base sites, access and utility corridors, borrow sources, and other M-X support facilities. This plan will include:

   (a) description of historic and cultural property types expected;

   (b) predicted distributions of historic and cultural properties;

   (c) study questions to be addressed;

   (d) study methods, including methods of field inspection, testing, and analysis;

   (e) study team composition;

   (f) data storage and management program.

B. Where prudent and feasible, in consultation with the SHPOs and BLM, the Air Force will avoid adverse effects on historic and cultural properties through design of M-X facilities by relocation of existing facilities or by other means.

C. In consultation with the SHPOs and BLM, the Air Force will develop guidelines for documentation or data recovery from historic and cultural properties that cannot be avoided or protected. The guidelines will take into account:

1. the data generated by the preliminary and intensive studies;

2. the concerns of local communities and social and ethnic groups;

3. the Native American Religious Freedom Act;

4. 36 CFR Part 66 and its appendices published by the Department of the Interior on January 28, 1978 (42 FR 5374-82);

5. the standards of the Society of Professional Archaeologists;

6. other applicable federal regulations, standards, and guidelines.

D. The Air Force will in a timely manner deliver copies of the initial study plans (II.A.1) and guidelines for data recovery (II.C) to the Review Committee, the state BLM offices, and the appropriate SHPO and afford them 15 working days after receipt, to review them. The Review Committee, SHPO, and BLM will provide written notice of receipt and indicate their objections, if any, within 15 working days. Should the Review Committee, SHPO, or BLM object, the Air Force will arrange a meeting to resolve differences before proceeding with the action to which the Review Committee, SHPO, or BLM has objected. If the difference cannot be resolved, the Air Force will take the comments to the Committee, SHPO, and BLM into account in deciding whether to and how to proceed.

E. When it is not prudent or feasible to avoid adverse effects upon a historic or cultural property, the Air Force will follow 36 CFR Part 1204 to determine whether the property is eligible for inclusion in the Register, and consult with the appropriate SHPO and BLM as appropriate, and,

1. if the affected property meets criteria for listing in the Register primarily because it may yield information important in prehistory or history, the Air Force will institute a documentation or data recovery program in accordance with the guidelines established under Stipulation II.C. Prior to initiating any documentation or data recovery program, the Air Force will notify the Review Committee, BLM, SHPOs, and any concerned local communities, or social, and ethinic groups. Should an objection be raised, the Air Force will consult with the objecting party to resolve the objection. If no agreement can be reached among the Air Force, the SHPO, and BLM on the documentation or data recovery program, the Air Force will request the comments of the Council pursuant to 36 CFR Sec. 800.6;

2. if the affected property is determined eligible for listing in the Register for reasons other than, or in addition to, its information

potential, the Air Force will consult with the appropriate SHPO to determine the nature of the undertaking's effect on the property and, pursuant to 36 CFR Sec. 800.4(d), request Council comments.

F. Pursuant to the American Indian Religious Freedom Act of 1978 (P.L. 95-341), the Air Force will consult with groups that have cultural ties to the study area in order to identify locations and issues of concern to them and to work with these groups and the parties to this Agreement in resolving conflicts. The Air Force will take the concerns of these groups into consideration during the design and construction of the undertaking, and during implementation of this Agreement.

G. During the implementation of any portion of the undertaking, should previously unknown historic or cultural properties be discovered, the Air Force will comply with 36 CFR Sec. 800.7 and/or the data recovery guidelines developed under paragraph C above.

H. Before M-X construction is complete, the Air Force will consult with the SHPOs and the BLM to establish preservation mechanisms to accompany operation and maintenance of the facilities. Operation and maintenance will also be covered under this Agreement.

III. The Air Force and the Council will work together as members of the Economic Adjustment Committee in an effort to ensure that federal government activities to accommodate population and infrastructure growth resulting from M-X deployment are sensitive to the historic and cultural values of the deployment areas. The parties agree in principle that the federal government should assist affected states and communities in the development and implementation of programs that will contribute to protection of the historic and cultural character of communities subject to short- or long-term growth as the mensurate in scope with the level of projected impact of the undertaking on each affected community, and include but not be limited:

A. identification of districts, sites, buildings, structures, and objects included in or eligible for inclusion in the Register within each community;

B. development and implementation of measures to minimize destruction and maximize preservation and reuse of historic sites, buildings, structures, districts, and objects in federal construction and assistance projects within each affected community;

C. establishment of design guidelines to make new construction as compatible as possible with the historic environment of each community; and,

D. establishment of measures to foster successful integration of new facilities into the existing cultural and architectural fabric of each community.

IV. Avoiding Inadvertent Damage During Pre-Construction Studies

A. The Air Force will ensure that proper coordination occurs between its personnel and contractors responsible for historic preservation and its personnel and contractors responsible for environmental, geological, engineering, and other studies, to minimize the danger posed to historic properties by geological testing, survey teams, and other activities and personnel. Intensive surveys will be conducted in advance of any land-modifying activity. Geological test sites and other locations of landmodifying activity will be designed to avoid damage to historic properties.

B. If test excavations are necessary to obtain data needed for the evaluation of historic properties under Stipulations II.A.2 and II.A.3 above, the excavations will not be allowed to exceed the scope necessary for basic evaluation, will not utilize mechanized equipment without the approval of the appropriate SHPO and BLM, and will be carried out in accordance with strict archaeological controls.

V. Definitions

As used in this Agreement:

A. Air Force means the United States Air Force acting by itself or through agents or contractors.

B. Historic and Cultural Properties means properties included in or likely to meet the criteria for inclusion in the National Register of Historic Places.

C. Historic Preservation includes, but is not limited to, the identification, evaluation, protection, rehabilitation, reuse, recording of, and salvage of historic properties.

D. Potential Impact Area means the area in which the undertaking may reasonably be thought to have potential positive or adverse, direct or indirect effects upon historic properties.

(date)

Executive Director

(date)

U.S. Air Force

(date)

Bureau of Land Management

(date)

Nevada State Historic Preservation Officer

(date)

Texas State Historic Preservation Officer

(date)

Utah State Historic Preservation Officer

(date)

New Mexico State Historic Preservation Officer

(date)

Chairman
Advisory Council on Historic Preservation

ATTACHMENT 1

Review Committee Guidelines

A. Responsibilities

1. To monitor progress of the M-X Historic Preservation Program and advise the Air Force and Council of any actions needed to ensure maintenance of high professional standards.

2. To review guidelines, scopes of work, research designs, survey reports, and other documents developed by the Air Force and to advise the Air Force and the Council on any changes appropriate to ensure maintenance of high professional standards.

3. To assist in the resolution of disputes that may arise over the quality or appropriateness of particular historic preservation related activities, or of the M-X Historic Preservation Program in general.

B. Organization

1. Membership will consist of:

   a. The Executive Director of the Council and the Secretary of the Air Force or their designees, who will co-chair the committee;

   b. the Director of BLM or his designee;

   c. The following non-federal members who will be appointed by the Executive Director and the Secretary of the Air Force:

      1) one professional archaeologist knowledgeable in the archaeology of each general basing region (e.g., Texas/New Mexico, Nevada/Utah

      2) one professional historian, preferably one with a knowledge of architectural history who is also knowledgeable in the history of each general basing region.

      3) other members as the Secretary of the Air Force and Executive Director may determine to be necessary.

2. Procedures:

   a. the committee will meet at the call of the co-chairmen;

   b. the committee may assign tasks to subcommittees or individual members.

   c. The Air Force will provide staff support; and,

d. the committee will forward any meeting announcements, minutes, and other documents afforded to committee members to the SHPOs.

3. Funding: The Air Force will fund:

   a. costs of travel and per diem;

   b. stipend not to exceed $100 per day for non-federal committee members engaged in committee business;

   c. postage and telephone.

ATTACHMENT 2

Guidelines: Calendar of Tasks

Task I

A. Initial study plan (II.A.1)
B. Establish review committee (I.A., Atch. 1)

Task II

A. Conduct preliminary studies (II.A.2)
B. Develop plan for intensive field survey (II.A.3)

Task III

A. Conduct intensive field survey (II.A.3)
B. Redesign to avoid historic properties where feasible and prudent (II.B).

Task IV

A. Determine eligibility and effect, and mitigate adverse effects (II.E)

Consultation occurs, and comments are considered, at the beginning and completion of each task.

APPENDIX B

HISTORIC AND ARCHITECTURAL PROPERTIES IN THE NEVADA/UTAH STUDY AREA

NEVADA HISTORIC BUILDINGS BY COUNTY

Clark County

Bunkerville

- Bunkerville Historic District (NRHP-Pending)
- Bunker House
- Iverson House (1893)
- Leavitt House (1894)
- Old Residence and Businesses still inhabited

Fort Baker

- Restored Mormon Fort on NRHP, now serves as a Museum

Las Vegas

- Las Vegas Grammer School - Branch #1 (NRHP-Pending)
- Blacksmith Shop (NRHP-Pending)
- Las Vegas Spring (NRHP)
- Kyle Ranch (NRHP)
- Many Historic Buildings/Objects remain

Mesquite

- Mesquite School
- Mesquite House (NRHP-Pending)
- Mesquite Cemetery
- Wheeler Wash Charcoal Kilns (AKA Tecopa Charcoal Ovens)

Elko County

Carlin

- Oldest town in Elko County

Currie

- Old School House

Deeth

- Several Old Houses
- Two Railroad Bridges on Texas Tech. Survey

Elko

- o Numerous Old Buildings
- o Freight Depot Built 1869/Second County Courthouse/Hospital
- o Southern Pacific Railroad Bridges (3) and Tunnel (1)

Esmeralda County

Diamondfield

- o As of 1970 two large stone buildings remained

Goldfield

- o Goldfield Hotel (in preparation for NRHP)
- o Ted Pickard House
- o School House
- o Esmeralda County Courthouse
- o Lyric Theatre
- o John S. Cook Bank
- o Numerous other standing buildings
- o Montezuma Line Kilns (in preserved original shape)

Silver Peak

- o Mine and Mill remains surveyed by Texas Tech. 1980
- o Some old buildings remain

Eureka County

Eureka

- o Eureka Historic District (NRHP)
- o County Courthouse
- o Sentinel Newspaper Building

Humboldt County

Winnemucca

- o W.C. Record House (NRHP-Pending)
- o Nixon Opera House (NP) (NRHP-Pending)
- o Humboldt County Courthouse (1918)
- o Roman Catholic Church
- o Winnemucca Grammer School (1917)
- o Roman Catholic Churck
- o Winnemucca Grammer School (1927)
- o Chinese Joss House
- o Chinese Cemetery

Lander County

Austin

- Grioly Store
- International Hotel
- Nevada Oldest Bank Building
- Many other Historic Buildings

Battle Mountain

- Still Functioning Mining Town

Cortez

- Still Functioning Mining Town

Hilltop

- Nine buildings and wooden houses remain

Lincoln County

Alamo

- One of the oldest continuously settled towns in southern Nevada
- School House
- Meeting House
- Residences
- Some of the buildings were hauled in from Delamar

Caliente

- Railway Depot - 1923 (NRHP)
- Other Historic Buildings still standing

Panaca

- State Historic Site #93 (Panaca Coop)
- State Historic Site #39
- Caapel Historic Site #182

Pioche

- Lincoln County Courthouse (NRHP)
- Cemetery (Boothill)
- Museum
- Masonic Temple
- Numerous other historic buildings

Delamar

- Stone Buildings and Cemetery Site on NRHP

Nye County

Berlin

- Berlin Historic District buildings restored and used by park district

Belmont (NRHP)

Belmont (NRHP)

- Brick Courthouse
- Ruins of Mills
- Homes and Businesses

Hot Creek

- Adobe and stone structures presently being used by Hot Creek Ranch

Ione

- Several buildings still intact
- Wooden Courthouse

Jefferson

- Houses still intact among canyon sides

Manhatten

- Early mining town still inhabited

Moore's Station

- Preserved original stage station

McIntyre Charcoal Kilns

- Remain in good condition

Rhyolite

- "Bottle House" built in 1905 by Tom Kelley
- Las Vegas and Tonopah Railroad Depot
- Ruins of 12 buildings

Round Mountain

- Still inhabited with historic buildings and homes

Silverbow

- Historic Buildings (and wooden cabins)
- Area still inhabited

Tonopah

- Mizpah Hotel (NRHP)
- Wooden head frame and hoist of butler's original claim
- Tonopah and Goldfield Railroad Depot
- Several other remaining Historic Buildings/Residences

Tybo

- Brick and wood structures remain
- Area still inhabited

Tybo Charcoal Kilns (NRHP)

- Two remaining

Washoe County

Reno

White Pine County

Cherry Creek

- Assay Office
- Saloons
- Jail
- Frame and stone buildings in business district (AB)

Cherry Creek Station

- Water stand
- Depot
- Freight Building

D-Bar Ranch (AKA Mike Umitia well)

- Log cabin, root cellar, outhouse, corral, windmill, trash wagon, trash.

Ely

- Complete railroad complex with depot, roundhouse, coaling tower, waterstand, engine shops.
- 1927 Latter Day Saints Tabernacle

Hamilton

- Bank
- Hotel
- Brick Courthouse built 1869

Lehman Orchard and Aqueduct (NRHP)

- Lehman Caves
- Rhodes Cabin (HABS - NRHP)

White Pine County

Lund

- Still inhabited Mormon Town

Mineral City

- Buildings from 1800s-1900s

Shell Creek

- Fort Schellbourne (NRPH)
- Original P.E. Buildings

UTAH HISTORIC BUILDINGS BY COUNTY

Beaver County

- Muir House (NRHP)
- Beaver County Courthouse (NRHP)
- Harriet S. Sheperd House (NRHP)
- Thomas Farzee House (NRHP)
- Dr. George Fennemore House (NRHP)
- Duckworth Grinshaw House (NRHP)
- Dennis Charles White House (NRHP)
- Marcus L. Sheperd Home (USR)
- Williams Hotel (USR)

Fort Cameron

- On NRHP
- Historical Buildings from 1873-1883 and from 1913 (Mormon School)

Frisco

- Intact Historical Buildings (Area Abandoned)

Greenville

- Brick Building built in 1884, still in use

Iron County

Buckhorn Springs

- Some buildings remain - built in 1870s - abandoned in 1940s

Cedar City

- o Pioneer Iron Works Blast Furnace (USR)
- o George Wood Cabin (USR/NRHP)
- o Joseph S. Hunter Home (USR)
- o Old Main and Old Administration Building, Southern Utah State College (USR)
- o UPRR Depot (USR)

Parowan

- o Parowan Third Ward Meeting House (USR/NRHP)
- o Jesse N. Smith House (NRHP)
- o Chapel built in East Ward in 1915-1918 (still in use - 1940)

Juab County

Callao (See Reference - Kepper 1980)

- o Pony Express Station (best preserved in state)
- o Hotel
- o Schoolhouse (best preserved in state)
- o Post Office

Eureka

Tintic Mining District (NRHP)

Majority of Mining Town is still intact

- o Carnegie Library
- o Second J.C. Penney Store in United States

Homansville

Tintic Mining District (NRHP)

- o Some intact buildings

Levan

- o LDS Church (USR)

Mammoth

- o Within Tintic Mining District (NRHP)
- o Numerous standing structures

Nephi

- o Goldsborough Hotel (USR) - destroyed
- o George Carter Whitmore Mansion (NRHP)
- o Booth House (NRHP)

Ward Mine

- Some structures of mining camp are intact

West Tintic

- Within Tintic Mining District (NRHP)

Millard County

Black Rock

- Historically Intact - railroad depot, equipment, some houses (abandoned)
- Burtner Dam Ruins (USR)

Delta

- Delta Sugar Factory Warehouse (USR)
- Delta Sugar Factory Club House (USR)
- McCullough Log House (USR)
- McCullough Log House and Post Office (USR)

Deseret

- Deseret School (USR)

Fillmore

- Fillmore Rock Schoolhouse (USR, HABS)
- Edward Partridge Home (USR)
- Fillmore American Legion Hall (USR)
- Utah Territorial Capital (NRHP)

Gunnison Bend Dam and Reservoir (USR)

Greenwood

- Some historically intact houses remain

Hinkley

- Millard Academy (USR)

Holden

- Steven's Home (USR)

Meadow

- LDS Church (USR)

McCornick

- o Homes intact (abandoned 1930s)

Sutherland

- o Brick schoolhouse built in 1912
- o USRR bridge across Sevier River (USR)

Millard County

Woodrow

- o Intact historical buildings
- o Woodrow Hall (USR)

Tooele

- o Bonneville Salt Flats Race Track (USR)

Clover

- o David E. Davis Home (USR)

Gold Hill

- o Most of the town is still intact
- o "Utah's largest, most complete ghost town - Carr - 1972."

Iosepa

- o Some of the original homes/buildings are intact

Jacob City

- o Some of the early mining related buildings are intact - hotel, houses, shacks, water tanks
- o Almost entire town is made up of abandoned, still intact buildings
- o Benson Mill (NRAP)

Ophir

- o Ophir Town Hall and Fire Station (USR)
- o Some historic buildings remain - post office, theatre, school.

St. Johns

- o Early Rock Meeting House

Simpson Springs

- BLM Reconstruction (1950s)

Tooele City

- Tooele County Courthouse (USR)
- Some historic buildings remain

Vernon

- John Sharp Home (USR)
- Historic buildings

Grande County

Moab

- Orlando W. Warner House NRHP
- Moab Cabin (Balsley Cabin) (NRHP pending)
- Arthur Taylor House (NRHP pending)

Utah County

Bingham

- Largest Copper Mine with continuous occupation

Camp Floyd

- Utah State Historic Park (NRHP)

Dividend

- Some historic buildings remain

Fairfield

- Stage Coach Inn on NRHP
- District School Gymnasium (USR)
- Clay Canyon Variscite Deposit (USR)

Payson

- Christopher F. (Jack) Dixon, Jr. House (NRHP)
- John Dixon House (NRHP)
- John Fairbanks Home (USR)
- Nebo Stake Tabernacle (USR)
- Peteetneet School (USR)
- Area known for historic buildings

Salem

- Ira W. Garner House (NRHP)

Washington County

Grafton

- o Grafton Church (USR)

Harmony

- o Fort Harmony site (NRHP pending)
- o Fort Harmony - Reter's Leap Historic District (USR)

Harrisville

- o Historic buildings remain

Leeds

- o Stirling Home (USR, HABS)

Middletown

- o Alexander F. McDonald Home (USR)

Pine Valley

- o Chapel and Tithing Office (NRHP)
- o Houses intact

Pinto

- o Some homes remain

Rockville

- o Deseret Telegraph and Post Office (NRHP, HABS)

Saint George

- o Thomas Judd House (NRHP)
- o Old Washington County Courthouse (NRHP)
- o St. George Tabernacle (NRHP)
- o St. George Temple (NRHP)
- o Brigham Young Winter Home and C.fice (NRHP)
- o William Blake Home (NRHP)
- o Main buildings of Dixie Coller (NRHP pending)
- o Alexander F. McDonald Home (USR)

Santa Clara

- o Jacob Hamblin House (NRHP)

Silver Reef

- Wells Fargo and Co. Express Building (NRHP)
- Many Historic Buildings remain

Toquerville

- Naeble Winery (USR, NRHP pending)
- Church and Relief Society (USR)

Washington

- Robert D. Covington House (NRHP)
- Washington Cotton Factory (NRHP)
- Washington Relief Society Hall (NRHP Pending)
- Washington Ward Chapel (USR)
- Fort Pearce (NRHP)

NEVADA TRAVEL ROUTES

Acoma Road - dates unknown

Amargosa - Greenwater (1906-12) - auto stage

Amargosa - Greenwater (1906) - toll road

Aurora - Manhatten Road (late 1870s) - stage line

Aurora - Silver Peak (late 1860s) - stage line

Augum - Cleveland to Osceola (1904) - stage mail route

Austin - Belmont (1870s) - stage line

Austin - Belmont (1880s) - mail route (tri-weekly)

Austin - Candalaria (1880s) - mail route (tri-weekly)

Austin - Egan Canyon (date unknown) - mail route (tri-weekly)

Austin - Fort Ruby Road (date unknown)

Austin - Hamilton (1868) - stage route

Austin - Reveille (1866 or 1867) - freight - stage line

Austin - White Pine County (1870) - stage route

Arrowhead Trail (dates unknown but modern)

Barberger Road (1901)

Battle Mountain - Lewis (1880) - mail route (tri-weekly)

Battle Mountain - White Pine County (1800s - exact date unknown) stage route

Belmont - Hiko (1867) - stage line

Belmont - San Antonio (1870s) - stage line

Belmont - Wadsworth (1880) - mail route (tri-weekly)

Big Smokey Valley - Ophir Canyon (1864-5) - wagon road

Blaine - Ely (1908) - stage route

Caliente - Delamar (1904) - stage line

California Crossing (date unknown) - river crossing

California - White Pine County (1800s - 1900s) - horse and wagon route

California - Eastern Nevada (1868) - stage route

Candelaria - Tonopah Road (1901-1904) - stage and freight route

Candelaria - Tonopah (1901-1902) - telephone lines

Cherry Creek - Aurum (1890) - weekly; (1904) tri-weekly - stage, mail route

Cherry Creek - Ely (1890-weekly) (1904-tri-weekly) - stage, mail route

Cherry Creek - Wells (1890-tri-weekly) 1904 (6 times per week) stage, mail route

Cobre - White Pine County (1870s) - freight route

Cole Creek - Eureka (1890 - weekly) - stage, mail route

Columbus - Candelaria (1876) - stage line

Columbus - Fish Lake Valley (1876) - stage line

Columbus - Lida (1876) - stage line

Columbus - Wadsworth (1876) - Express Stage; (1873-1882) - freight route

Death Valley Emigrant Trail (1840s); (1849) - Death Valley Party, Manly party

Deep wells - Belmont (1881) - stage line

Deep wells - Downeyville (1881) - stage lines

Deep wells - Grantsville (1881) - stage lines

Delamar - Milford Road (mid-late 1880s) - mine company freighting road

Diamondfield - Goldfield (1903) - toll road

Donner Trail (1864) - wagon route

Downeyville Express (1878) - Wells Fargo Route

Downeyville Route (1878) - stage line

Egan Canyon - Humboldt Wells (dates unknown) - stage line

Egan Trail (1850-60)

Elko - Eureka (1880) - mail route

Elko - Hamilton (dates unknown) - saddle train and stage line

Ellendale - Tonopah (1909) - telegraph line

Ellsworth - Wadsworth (1860s) - freight route; (1860s) stage line

Elko - Hamilton (date unknown) - Hill Beach Stage Line, Wells Fargo Stage Line (1869) - Pacific Union Express Stage

Elko - Pioche (date unknown) - wagon road

Elko - Salt Lake City (1869) - stage route

Ely - Duck Creek (1904) - stage, mail route (bi-weekly)

Ely - Eureka (1897) telephone line (1890-1904) - stage, mail route

Ely - Frisco, Utah (1890 - bi-weekly) (1904-tri-weekly) - stage, mail route

Ely - Sunnyside (1890) mail route; (date unknown) - telephone line

Ely - Sunnyside - Pioche (1904) - stage, mail route (tri-weekly)

Esmeralda Toll Road (date unknown)

Eureka - Belmont (1880) - mail route

Eureka - Hamilton (1870s) - stage line

Eureka - Palisade - Hamilton (1871) - fast freight, stage

Eureka - Pioche (1880) - mail route (tri-weekly)

Goldfield - Rhyolite (1905) - stage line, express stage, mail route

Gold Hitt - Basalt (1905-06) - stage line

Goose Creek - Humboldt (date unknown) - Emigrant Trail

Grantsville - Ione - Austin (dates unknown) - stage line

Grantsville - Belmont - Eureka (dates unknown) - stage line

Hamilton - Carlin (dates unknown) - stage route

Hamilton - Eberhardt - Treasure City (1870s) - mail route

Hamilton - Eberhardt (1870s) - toll road

Hamilton - Elko (1871) - stage line; (1870s) - Woodruff and Envors

Hamilton - Eureka (1872-1876) - freight line

Hamilton - Elko (1870s) - stage route

Hamilton - Ely (1904) - stage, mail route (bi-weekly)

Hamilton to Central Pacific Railroad at Humboldt River (1870s) Wells Fargo Stage

Hamilton to Stockdale (1904) - stage, mail route (bi-weekly)

Hamilton - Tempiute Road (1870s) - road

Hamilton - Treasure Hill (1870s) - stage route

Hill Beach Road and Telegraph Line (Hobson Toll Road) (1869) shipping and stage route

Holladay Overland Route (1862) - Overland Coach Line, mail service

Hot Creek Station - Duck Water Station Road (dates unknown)

Ivanpah - Bullfrog (dates unknown) - stage line

Jefferson - Belmont (dates unknown) - toll road

Johnnie - Amargosa (dates unknown) - stage line

Las Vegas - Rhyolite (1905) - stage, mail, express line

Lincoln Highway (1919-1926) - built

Logan Springs - Crescent City (unknown date) - wagon road

Dummy mail routes, fraudulent routes (1880s)

Manhatten - Round Mountain (1908) - stage lines (daily)

Marvel - Bullfrog (early 1900s) - road

Midland Trail (1916)

Mineral City - Cherry Creek (date unknown) - stage line

Mineral City - Hamilton (1870s) - stage line

Monarch - Manhatten (1906) - stage, express line

Morey - Duckwater (1880s) - stage, mail route (weekly)

Nevada 46 (1940) - road

Ophir Canyon - Austin (1865-6) - stage route

Osceola - Frisco (1880) - mail route (tri-weekly)

Osceola - Geyser (1890) - stage, mail route (weekly)

Osceola - Pioche (1904) - stage, mail route (bi-weekly)

Overland Mail and Telegraph Company (1861-9) - stations, telegraph lines, mail

Overland stage (1860s) - stage line

Pahranagat - Austin (1866) - wagon route, stage route

Pahranagat Valley to White Pine Valley Road (date unknown)

Palisade to Bullion (1880) - mail, stage route (tri-weekly)

Palisade - Hamilton (1876) - stage line

Panaca - Mount Irish (date unknown) - road

Panaca - Muddy Valley (date unknown) - mail route

Pioche - Belmont (late 1880s) - road

Pioche - Bristol - Eureka (late 1880s) - stage line

Pioche - Hamilton (1890s) - stage, telegraph lines

Pioche - Hiko (1880) - mail route (bi-weekly)

Pioche - Jackrabbit (date unknown) - telegraph line

Pioche - Milford (1888) - wagon route, mining

Pioche - Mineral Park (Arizona) (1880) - mail route

Pioche - Palisade (late 1880s) - stage line

Pioche - Pangwitch Lake (1875) - Buck trip - route

Pioche - Pony Spring (late 1880s) - mail express

Pioche - San Francisco, California (dates unknown) - stage line

Pioche - Utah State Railroad (1880) - mail route (daily)

Pony Express (1860)

Prospect - Eureka (date unknown) - stage line

Ruby Valley - Fair Play (1880) - special mail route

San Francisco - White Pine County - water transport route

Schellbourne - Aurum (1880) - special mail route

Silverbow - Tonopah (1905) - stage line (weekly)

Sodaville - Tonopah (1901-2) - telephone line; (late 1800s - 1904) stage line (1901) - road

Spanish Trail (1829) - trail

Spruce Mountain - Arthur (1880) - mail route

Toano - Deep Creek (Gold Hill) (1870s) - freight line

Toano - Pioche (1870-73) - freight line (1870s) - wagon road

Toano - Robinson (date unknown) - freight line

Tonopah - Clifford (1908) - stage line

Tonopah - Manhatten (dates unknown) - stage line

Tonopah - Round Mountain (1906) - stage, freight lines

Tonopah - Wahmonie (1928) - auto stage

Transvaal - Beatty (date unknown) - stage line

Tybo - Eureka (1877) - freight line (1870s) - stage line

U.S. 6 (1940) - road

U.S. 40 (1940) - road

U.S. 50 (1940) - road

U.S. 91 (1940) - road

U.S. 93 (1940) - road

U.S. 95 (1940) - road

Warm Springs - Eureka (date unknown) - stage line

Wells - Hamilton (1880) - mail route

UTAH TRAVEL ROUTES

Salt Lake City - Southern Utah (1863) - Ajax Road

Bear River - California Routes (1883) - route used by trappers

Salt Lake City to California (1854) - Beckwith Trail

Camp Douglas - Fort Critterden, Utah (1863) - military route, California volunteers

Camp Douglas - Fort Mohave, Nevada (formerly Arizona) (1864) - military route

Camp Floyd - Ruby Valley (1859) - mail route

Cedar City mail route (1859) - mail route

Deseret Telegraph (1871) - telegraph line

Dry Canyon - Stockton Road (1876) - mining road

Fort Bridger - Fort Summit, California (1846) - wagon route, Donner Party

Fort Bridger - Fort Summit, California (1846) - wagon route, Harlan Party

Fort Bridger - Sutter's Fort (1846) - wagon route, Clyman Party

Fort Hall - Salt Lake City (1849) - military route, surveyors

Gilmer and Salisbury Stage Line (1860s) - served Cove Fort

Gold Hill (Deep Creek) - Salt Lake City (date unknown) - mail route

Great Salt Lake to California Route (1845) - Fremont Group

E.T. City - Corinne (1870s) - Great Salt Lake Boat and Barge Route

Hastings Cutoff - Pioute (1840s) - wagon route

Emigrant Trail - Iosepa Road (late 1880s - early 1910)

Lewiston Canyon Road (established 1869)

Lewiston (Mercur) stageline (1873-4)

Lincoln Highway (early 1930s)

Mammoth - Eureka Road (date unknown) auto stage

Mercur - Manning - SR 73 Road (late 1860s) - wagon road

Nephi - York Road (date unknown) - wagon road

Ophir Road - SR 73 (1870s - 1880s) - wagon road

Ophir - Mercur Road (1870s) - wagon road

Ophir Stage line (pre-1918)

Overland Canyon Road (1880s - 1990s) - wagon road

Overland Mail Line (or Egan Trail) or Overland Stage (1860s) - mail route

Pony Express (early 1860s-1861) - mail route

Salt Lake to Hiko Line (date unknown) - stage line

Salt Lake City to Nevada line (date unknown) - Overland stage route

Salt Lake City (Deseret Company) - Pioche Line (1871) - telegraph line

Salt Lake City to Treasure City Line (date unknown) - stage line

Sevier River Road (1879) - wagon road

Sevier City Road (date unknown)

Silver City - Diamond Road (date unknown)

Silver City from Provo Line (early 1870s) - stage and mail line

Simpson Road (Salt Lake City to Carson Sink) (1859) - route

Old Spanish Trail (1850s, 60s, 70s) - Spanish Trail

Sunshine Road (1890s) - wagon road

Tooele City Road (1855) - wagon road

Topaz - Topaz Mountain Road (date unknown) - road

U.S. 6 (1941) - road

U.S. 21 (1941) - road

U.S. 40 (1941) - road

U.S. 50 (1941) - road

U.S. 91 (1941) - road

U.T. 15 (1941)

U.T. 36 (1941)

Western Canyon - Sutter's Fort, California (1846) - wagon road

NEVADA RAILROADS

American Carrara Marble Company Railroad (1913-1916) - mining railroad

Austin City Railway (1889) - mining railway

Battle Mountain - Austin railroad

Battle Mountain - Lewis Railway (1881-1980)

Bullfrog and Foldfield Railroad (1906-07)

Caliente and Pioche Railroad (1906-1979)

Carson and Colorado Railroad (1881-1960)

Central Pacific Railroad (1867-present)

Comets Spur, Spur of the Caliente to Pioche Railway (1907)

Cortez Mines Ltd. Railway (date unknown) - mine railway

Deep Creek Railroad (1917-1937)

Eureka and Colorado Railroad (1876)

Eureka and Palisade Railroad (1875-1938)

Eureka and Ruby Hill Railroad (or Ruby Hill RR) (1875) - mine railroad

Goldfield Consolidated Milling Company Railroad (1908) - mine railroad

Goldfield Railroad (1905) - merged with Tonopah Railroad in late 1905

Las Vegas and Tonopah Railroad (1907-1919)

Mineral Ridge to Silver Peak Tramway (date unknown) - mine - gravity tramway

Nevada Central Narrow Gauge Railroad

Nevada Central Railway (1879-1938)

Nevada Northern Railway (1906-Present)

Pahranagat Mines Tramway (dates unknown) - mining

Pioche and Bullionville Railroad (or Central Nevada Railroad) (1872-31884)

Pioche Pacific Transportation Company (1891-1899) - railroad

Pittsbury Silver Peak Gold Mine Tram System (1907) - mining

Prince Consolidated Railroad (1912 - present) - mining

Salt Lake Route (now part of Union Pacific (1912) (1905 - present)

San Pedro, Los Angeles and Salt Lake Railroad (built 1902-4)

Silver Peak Railroad (1906-1918) - mining spur

Six Companies, Inc. Railroad (1930s-1962) - built for construction of Hoover Dam

Southern Pacific and Oregon Short Line to Salt Lake (date unknown) mining

Tonopah Railroad (or Tonopah Goldfield Railroad) (1903 1905 merged 1948)

Tonopah and Tidewater Railroad (1908-1940)

Treasure Hill - Eberhardt Tramway (1869) - mining

Union Pacific Railroad - Boulder City Branch (1930s) - construction of Hoover Dam

U.S. Government Construction Railroad (1930-1962) - for construction of Hoover Dam

Utah and Pacific Railroad (1898)

Utah Southern Railway (1876)

Western Pacific Railroad (1907 - present)

Yellow Pine Mining Company Railroad (1910-1930) - mining

UTAH RAILROADS

Bringham Canyon Railroad (1873)

Cedar City - Lund Branch of the Los Angeles, and Salt Lake Railroad

Deep Creek Railroad (1917)

Delta - Fillmore (Branch of the Los Angeles and Salt Lake Railroad)

Denver and Rio Grande Western Railroad (1910)

Eureka Spur of the Los Angeles and Salt Lake Railroad

Eureka Branch of the Denver and Rio Grande Western Railway

Frisco Branch of the Los Angeles and Salt Lake Railroad

Goshen Valley Railroad (1919) - In 1919 branch of the Tintic Range Railroad

Uncle Jesse Knight's Narrow Guage Mining Railroad (1907)

Los Angeles and Salt Lake Railroad (1890s)

Pioche and Bullionville Railroad - bought in 1884 and moved from Nevada to coal mines east of Cedar City

Robinson Railroad (1890) - mining railroad

Salt Lake and Mercur Railroad (1896)

Salt Lake Railroad (early 1900s) - part of the San Pedro, Los Angeles, and Salt Lake Railroad, now main line of Union Pacific Railroad

Salt Lake - Sevier Valley - Pioche Railroad (1870s) - However, tracks never laid past Milford, Utah

Salt Lake and Western Railroad (1870s)

St. John and Ophir Railroad (1900-1910)

Tintic Range Railroad (1892)

Transcontinental Railroad (1869)

Union Pacific Railroad

Utah Central Railroad (1869)

Utah Southern Railroad (1875)

Utah Western Railroad (1875)

Western Pacific Railroad (1906)

APPENDIX C

Historical and Architectural Properties in the Texas/New Mexico Study Area

Appendix D lists the properties within the study area compiled in the National Register of Historic Places, the Texas Historic Sites Inventory, and the Texas Tech Univeristy Historic Engineering Sites Inventory (HESI). All of the properties listed by the HESI in the Texas portion of the study area are also in the State Historic Inventory; these properties are listed only under the HESI. This appendix does not include properties which are included on any of these lists which are of primarily archaeological significance.

Property	County	Date/ Period	Style or Significance
National Register of Historic Places:			
E.B. Black House	Deaf Smith, Tx.	1909	Victorian
Mary Birins Library	Potter, Tx.	1905	Georgian Revival
Landergin-Harrington House	Potter, Tx.	1914	Classic Revival
McBride Ranch House*	Potter, Tx.	1903	Partial dugout
L. T. Lester House	Randall, Tx.	1901	Victorian (Queen Anne)
James Phelps White House	Chaves, N. Mex.		
Fort Sumner Ruins	DeBaca, N. Mex Ca.	1860	Historic fort
Fort Sumner Railroad Bridge	DeBaca, N. Mex.	1905	Railroad
Richardson Store	Quay, N. Mex.		
Texas Historic Sites Inventory:			
Muleshoe Ranch Cookhouse*	Bailey	1897	Ranch building
Slaughter Ranch House	Cochran	1915	Spanish Colonial
St. James Episcopal Church	Dallam	1910	Victorian (Queen Anne)
Meth. Episcopal Church	Dallam	1914	Religious structure
Deaf Smith Co. Courthouse	Deaf Smith	1910	Classic Revival
Channing Methodist Church	Hartley	1898	Victorian (Gothic Revival)

*Rural site (at present or when originally built)

Property	County	Date/ Period	Style or Significance
XIT Ranch Headquarters	Hartley	1890	Victorian
Hartley Co. Jail	Hartley	1892	Stone vernacular
Tascosa Courthouse	Oldham	1884	Stone vernacular
Farwell Bank Building	Parmer	1907	Renaissance Revival
McBride Ranchouse*	Potter	1903	Ranch building
Lee Bivens House	Potter	1901-1929	Classic Revival
A. G. Boyce House	Potter	1901-1929	Mission Revival
Capital Hotel	Potter	1901-1929	Renaissance Revival
Allen Early Second House	Potter	1901-1929	Classic Revival
First Baptist Church	Potter	1890	Victorian
Griggs House	Potter	1901	Victorian
J. L. Harrington House	Potter	1901-1929	Classic Revival
J. L. Harrington Grocery	Potter	1901-1907	Victorian Commercial
W.E. Herring House	Potter	1901-1929	Classic Revival
Houghton House	Potter	1901-1929	
Gustavus Kilbourne House	Potter	1901-1929	Victorian
Nichols House	Potter	1901-1929	Classic Revival
Rock Island Depot	Potter	1901-1929	Railroad
H. B. Sanbourne House	Potter	1901-1929	Victorian
Santa Fe Depot	Potter	1901-1929	Railroad
Lon Selers House	Potter	1901-1929	Victorian
J. D. Shuford House	Potter	1901-1929	Classic Revival
Willis D. Twitchell	Potter	1901-1929	Victorian
First Baptist Church	Potter	1890	Gothic Revival

*Rural site (at present or when originally built)

Property	County	Date/ Period	Style or Significance
1106 S. Tyler St.	Potter	1901-1929	Victorian
1119 S. Harrison St.	Potter	1901-1929	Victorian
118 S. Harrison St.	Potter	1901-1929	Classic Revival
1612 S. Polk St.	Potter	1874-1900	Victorian
1710 S. Polk St.	Potter	1901-1929	
1712 S. Polk St.	Potter	1901-1929	
1716 S. Polk St	Potter	1901-1929	Eclectic
203 S. Lincoln St.	Potter	1874-1900	Victorian
218 S. Lincoln St.	Potter	1874-1900	Victorian
2 W. 11th St.	Potter	1901-1929	Victorian
416 W. 4th St.	Potter	1901-1929	Symmetrical Victorian
706 S. Harrison St.	Potter	1901-1929	Victorian
W. R. Curtis House	Potter	1901-1929	Classic Revival
J. W. Danner House	Potter	1901-1929	Classic Revival
E. L. Dohoney House	Potter	1901-1929	Classic Revival
Frying Pan Ranch House*	Potter	1874-1881	Ranch building
L. T. Lester House	Randall	1901	Victorian (Queen Anne)
T. Anchor Ranch Headquarters*	Randall	1877	Log building
Texas Tech University Historical Engineering Site Inventory:			
Warren Ranch/Farm Irrigation Well	Bailey, Tx.	1901	Water control
Dalhart Army Airfield	Dallam, Tx.	1942	Military airfield
XIT Dam	Deaf Smith, Tx.	1917	Water control
D. L. MacDonald Frio Draw Irrigation Well	Deaf Smith, Tx.	1910	Water control

*Rural site (at present or when originally built)

Property	County	Date/ Period	Style or Significance
Tierra Blanca and Frio Draw Irrigation Project	Deaf Smith, Tx.	1910	Water control
Stant Rhen Stage Stand	Hale, Tx.	1901	Transportation
Upright Oil-burning Irrigation Engine	Hale, Tx.	1914	Water control
Plainview Water Works	Hale, Tx.	1912	Water control
Plainview Irrigation District	Hale, Tx.	1910-1915	Water control
Plainview Field	Hale, Tx.	1942	Military/airfield
Lake Plainview	Hale, Tx.	Ca. 1913	Water control
Green Machine Company	Hale, Tx.	Ca. 1915	Industry
John Henry Slaton Irrigation Well	Hale, Tx.	1911	Water control
Plant X Electric Generation Station	Lamb, Tx.	1952	Energy
LFD Irrigation System	Lamb, Tx.		Water control
Rock Line Kiln	Moore, Tx.	Ca. 1890	Early industry
XIT Ranch Electric Fence and Telephone Line	Oldham, Tx.	1888	Ranching
Salinas Lake Salt Supply	Oldham, Tx.	1800-1840	Historic
Alamocitos Irrigation System	Oldham, Tx.	1910	Water control
Cliffside Helium Field	Potter, Tx.	1927	Industry
Amarillo Army Air Field	Potter, Tx.	Ca. 1942	Military/airfield
Singing Median	Randall, Tx.	Ca. 1958	Transportation
Overland Freight Station	Shermand, Tx.	Ca. 1880	Historic transportation
Vaughan Bros. Oil-burning Irrigation Engine	Swisher, Tx.	1914	Water control
Tulia Waterworks	Swisher, Tx.	Ca. 1880	Water control

Property	County	Date/ Period	Style or Significance
Lake Van	Chaves, N. Mex.	1890	Water control
Atlas Missile Sites	Chaves, N. Mex.	1961	Military
Goddard Rocket Collection	Chaves, N. Mex.	1930	Scientific
Rio Feliz Timber Bridge	Chaves, N. Mex.	1920	Transportation
Salt Creek Bridge	Chaves, N. Mex.	1938	Transportation
Rio Feliz Bridge	Chaves, N. Mex.	1926	Transportation
Pecos River Bridge, Roswell	Chaves, N. Mex.	1939	Transportation
Northern Canal	Chaves, N. Mex.	1890	Water control
Hondo Project	Chaves, N. Mex.	1907	Water control
Federal Fish Hatchery	Chaves, N. Mex.	1932	Engineering
Stone Family Irrigation System	Chaves, N. Mex.	1880	Water control
Falsey Draw Bridge	Chaves, N. Mex.	1938	Transportation
Hyes and Bonney Ice Plant	Chaves, N. Mex.	Ca. 1900	Industry
Hope Retard Dam	Chaves, N. Mex.	1941	Water control
Canal Bridge	Chaves, N. Mex.	1938	Transportation
Dexter Wells	Chaves, N. Mex.	1893	Water control
Pecos River Bridge, Dexter	Chaves, N. Mex.	1907	Transportation
A. T. and S. F. Railroad Depot	Curry, N. Mex.	1908	Railroad
Fort Sumner Railroad Bridge	DeBaca, N. Mex.	1906	Railroad
Sumner Dam	DeBaca, N. Mex.	1937	Water control
Taiban Bridge	DeBaca, N. Mex.	1933	Transportation
Pecos River Bridge, Fort Sumner	DeBaca, N. Mex.	1926	Transportation
Taiban Creek Bridge	DeBaca, N. Mex.	1933-1933	Transportation
Yeso Bridge	DeBaca, N. Mex.	1934	Transportation

Property	County	Date/ Period	Style or Significance
Goodnight-Loring Trail	DeBaca, N. Mex.	1866	Transportation
Fort Sumner Railroad Depot	DeBaca, N. Mex.	1906	Railroad
Fort Sumner Railroad Bridge No. 2	DeBaca, N. Mex.	1939	Railroad
Fort Sumner Irrigation District Canal System	DeBaca, N. Mex.	1950	Water control
Fort Sumner Irrigation District Conversion Dam	DeBaca, N. Mex.	1950	Water control
Fort Sumner Bridge	DeBaca, N. Mex.	1915	Transportation
Eclipse Windmill	DeBaca, N. Mex.	Ca. 1900	Water control
Arroyo de Anil Bridge	DeBaca, N. Mex.	1937	Transportation
SEC Corporation Dry Ice Plant and Pipeline	Harding, N. Mex.	1939	Industry
Orchard Ranch	Harding, N. Mex.	Ca. 1885	Water control
Dry Ice Plant	Harding, N. Mex.	Ca. 1948	Industry
Solano Water Stop	Harding, N. Mex.	Ca. 1907	Railroad
Ranger Lake Windmill	Lea, N. Mex.	Ca. 1880	Water control
South Plains and Santa Fe Railway	Lea, N. Mex.	1928	Railroad
Texas/New Mexico Railway	Lea, N. Mex.	1930	Railroad
Baisn No. 1 Oil Well	Lea, N. Mex.	1926	Industry
Plaza Largo Creek Bridge	Quay, N. Mex.	1937	Transportation
Highway 66 Timber Bridge No. 2	Quay, N. Mex.	1931	Transportation
Highway 66 Concrete Bridge	Quay, N. Mex.	1936	Transportation
Montoya Bridge No. 1-3	Quay, N. Mex.	1936	Transportation
Montoya Railroad Trestle	Quay, N. Mex.	Ca. 1910	Railroad
Rock Island Railroad Bridge	Quay, N. Mex.	1935	Railroad
San Juan Creek Bridge	Quay, N. Mex.	1929	Transportation

Property	County	Date/ Period	Style or Significance
Canadian River Bridge	Quay, N. Mex.	1954	Transportation
Portales Windmills	Roosevelt, N. Mex.	Ca. 1900	Water control
Portales Irrigation Project	Roosevelt, N. Mex.	1911	Water control
Dry Stone Fence	Union, N. Mex.	1870	Historical
Oklahoma State Line Bridge	Union, N. Mex.	1935	Transportation
Old Clayton Dam	Union, N. Mex.	Ca. 1900	Water control
Clayton Windmill Turbine Generator	Union, N. Mex.	1977	Energy
Cienaguilla Creek Bridge	Union, N. Mex.	Ca. 1920	Transportation
Carrizozo Creek Bridge	Union, N. Mex.	1914	Transportation
Colorado and Southern Railroad	Union, N. Mex.	1887	Railroad
Colmor Cutoff	Union, N. Mex.	1930	Railroad
Devoy Flume	Union, N. Mex.	1908	Water control
Clayton Railroad Depot	Union, N. Mex	1888	Railroad
Clayton Dam	Union, N. Mex.	1954	Water Control
Dry Cimarron River Irrigation Canal	Union, N. Mex.	Ca. 1910	Water control
Dry Cimarron River Bridge	Union, N. Mex.	Ca. 1910	Transportation
State Line Brige	Union, N. Mex.	1928	Transportation
Southern Pacific Railroad	Quay, San Miguel, Harding, N. Mex.	1902	Railroad
Belen Cutoff	Valencia, Torrance, Guadalupe, DeBaca, Curry, N. Mex.	1902	Railraod
Recos Valley and Northeasterr Railway	Eddy, Chaves Roosevelt, N. Mex.	1898	Railroad
Panhandle Oil Field	Wheeler, Gray, Carson, Hutchinson, Potter, Tx.	1916	Industry

Property	County	Date/ Period	Style or Significance
Chocktaw, Oklahoma, and Texas Railroad	Carson, Gray Oldham, Potter, Wheeler, Tx.	1901	Railroad
Chisom Trails	Tom Green, Oldham, Bailey, Potter, Tx.	Ca. 1875	Transportation
Lake Mereditch	Hutchinson, Moore, Potter, Tx.	1962	Water control
Fort Worth and Denver South Plains Railroad	Castro, Floyd, Hale, Hall, Lubbock, Tx.	1925	Railraod
St. Louis, Rocky Mountain, and Pacific Railway	Union, Colfax, Tx.	1905	Railroad
Amarillo to Roswell Furrow	Potter, Randall Deaf Smith, Parmer, Tx., Chaves, N. Mex.	Ca. 1889	Transportation

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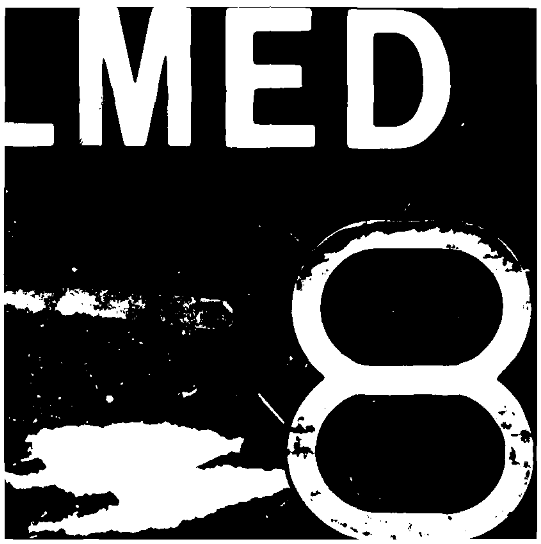
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